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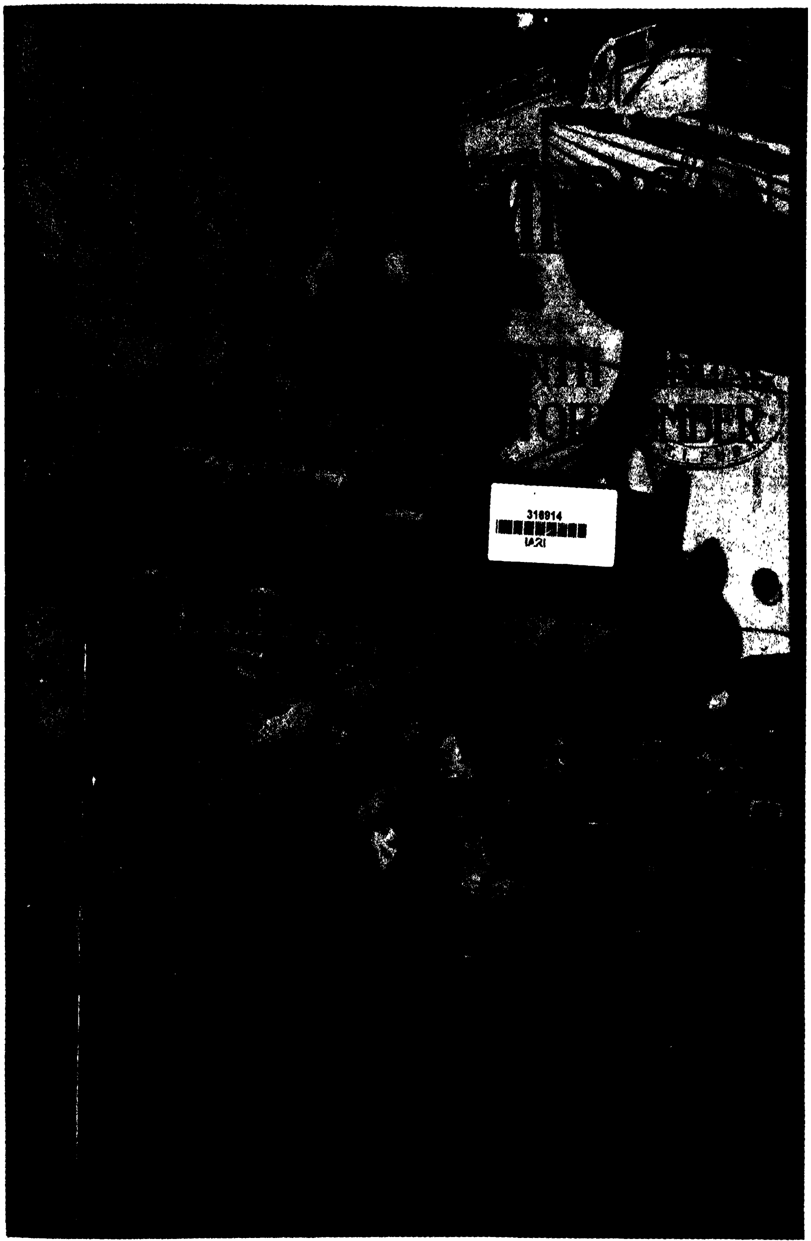

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Vol. CX. No. 1
January 3, 1914

Munn & Co., Inc., Publishers
New York, N. Y.

Price 15 Cents
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Truck Buying Narrows Down to Four Rival Makers!

Fierce Competition for Supremacy!

Competition in truck selling is now practically limited to four famous makes. That is, among the experienced buyers.

The aggregate resources of these four makers is over $25,000,000. Their yearly output is high up in the millions. Their supremacy is assured. Their guarantees are safe.

Two of these four famous makers build Trucks in excess of five tons capacity. All four build Trucks to haul three-ton loads. In the two-ton field choice is restricted to three makes, and the Velie alone builds a standard one-ton truck.

The three-ton Trucks built by these four famous makers are the best basis for comparative specifications. And because each of these four manufacturers is building the best truck he can, the difference in specifications is not great.

Perhaps the most noticeable difference is in the power of the motor. And here the Velie motor exceeds the average of its three competitors by 6 horsepower, and exceeds that of one of the famous four by 15 horsepower.

In Strength of Frame, three of these four Trucks use a frame 6 inches deep and one a frame 5 inches deep. But the 6-inch Velie frame is reinforced by a 4-inch sub-frame.

The value of this is perhaps not noticeable except on an extremely heavy load or in its general effect upon the long life of the Truck.

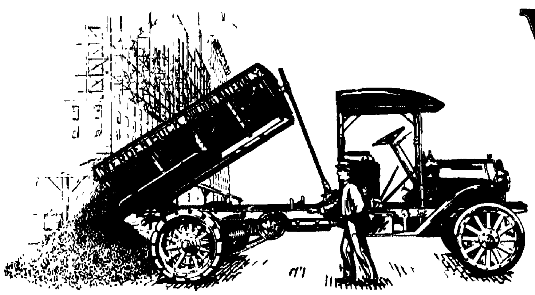
The average size of the rear wheel —the wheels that furnish the driving —is 39x4 inches. The Velie, with its 40x5-inch rear wheels, has larger equipment than any of the other three.

This same slight advantage in specifications holds equally true in a comparison of the three two-ton Trucks.

In the one-ton Truck field the Velie shows 25 per cent more power than any of the best known Trucks of this capacity now being built.

Everywhere—as a result of competitive tests between the four greatest American Trucks, the records of which any Velie dealer can show—the Velie Truck is being used by the great corporations, who buy Trucks by the dozen.

Velie



Velie Motor Vehicle Co., 1004 Velie Place, Moline, Ill.

Studebaker

"SIX"

ELECTRICALLY STARTED
ELECTRICALLY LIGHTED
SEVEN-PASSENGER

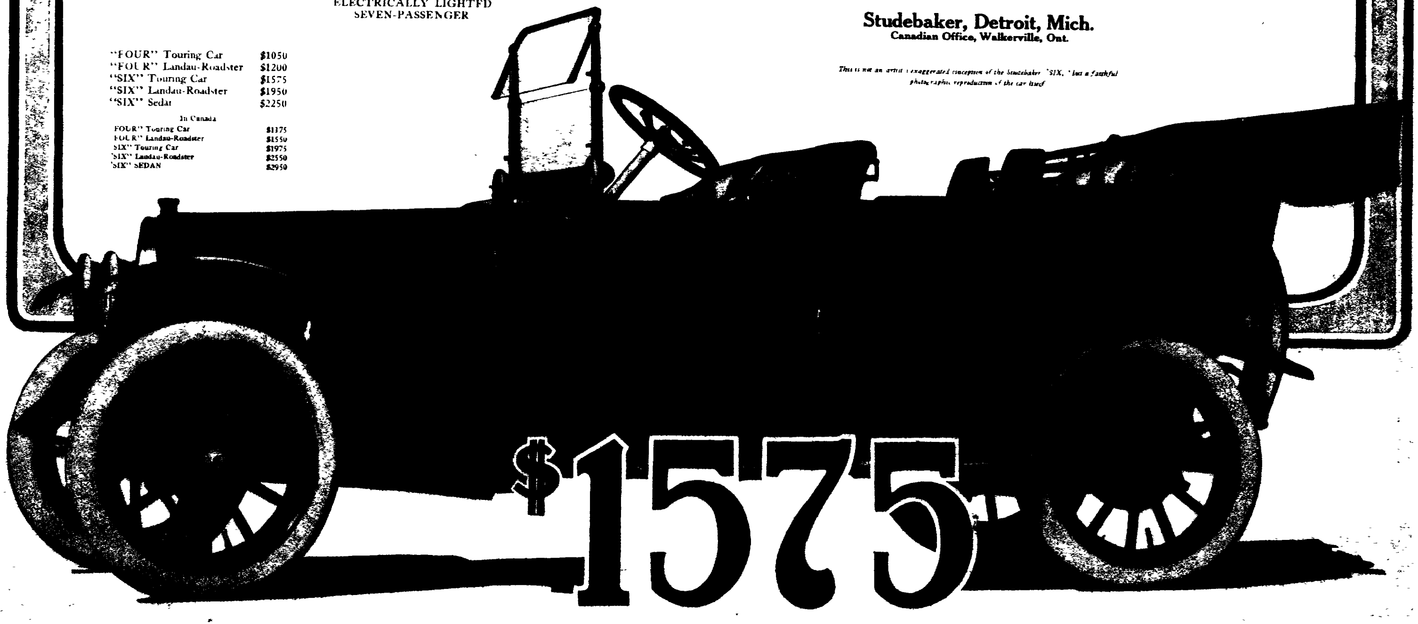
"FOUR" Touring Car	$1050
"FOUR" Landau-Roadster	$1200
"SIX" Touring Car	$1575
"SIX" Landau-Roadster	$1950
"SIX" Sedan	$2250
In Canada	
"FOUR" Touring Car	$1375
"FOUR" Landau-Roadster	$1550
"SIX" Touring Car	$1975
"SIX" Landau-Roadster	$2550
"SIX" SEDAN	$2950

"Buy It Because It's a Studebaker"

At a price lower than the price of any other "Six" in the world.

Studebaker, Detroit, Mich.
Canadian Office, Walkerville, Ont.

This is not an artist's exaggerated conception of the Studebaker "SIX," but a faithful photographic reproduction of the car itself

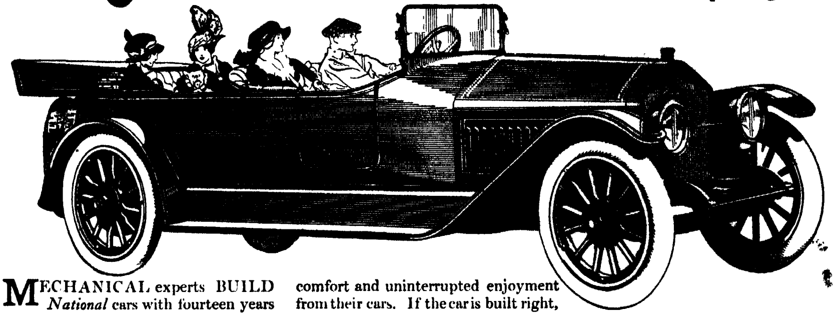


Machinist or Motorist?

You don't have to be a mechanical expert to safely buy a

National Six—$2375

Four and five-passenger



MECHANICAL experts BUILD *National* cars with fourteen years experience to guide them.

But women and men who do not claim to be authorities on machinery BUY *National* cars as safely as though they were experts. Motorists have faith in the company that builds and guarantees *National* cars, because the world-famed signature *National* is not only a name of a car but the mark of quality.

We welcome a detailed analysis of the *National;* we invite you to visit and inspect our factories. But what motorists demand today is service, confidence, comfort and uninterrupted enjoyment from their cars. If the car is built right, if the right materials are put in the right place, if the design is correct and the workmanship good, you can then avoid the work of "going over a car with a fine tooth comb." That way of buying a quality car is obsolete.

You can't find a better built car than the *National* if you use a microscope. We give you all you can possibly demand in a high-grade motor car, and give it to you with complete abandon of worry about what is under the hood or beneath the seat.

Brief Specifications—
***National* Six**

Motor, 6-cylinder, 3¾x5½-inch, cast en bloc. Tire pump, integral part of motor. Clutch, self-contained aluminum cone. Starting and lighting, electric two-unit system. Transmission, sliding gear selective type, three speeds forward, one reverse. Gauge, 56 inches. Oiling, crank-case constant level, force feed, with gear-driven pump. Ignition, high tension, dual magneto with storage battery. Tires, 36x4½. Firestone demountable rims. Air-pressure gasoline feed, generated by small pump in crank-case. Capacity, 23 gallons. Automatic carburetor. Two sets of brakes on 16-inch rear wheel drums. Bevel gear drive through straight line shaft with universal joints and torsion member. Full-floating rear axle. Left-side drive. Access all four wide doors. Single lever in center controls all speeds. Half elliptic springs, front; special *National* construction, rear.

Equipment:--Top complete with side curtains and boot, ventilating rain vision windshield, extra Firestone rim, electric lighting and starting systems, 12-inch double bulb electric headlights, electric license tail light, Warner speedometer, electric horn, tools and jack.

"You don't have to raise the hood"

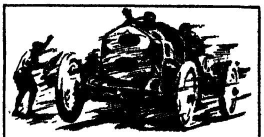
NATIONAL owners have learned that we build *whole* cars—the name *National* is their guarantee. Every *National* car is built as a *unit*—every mechanical part operates harmoniously to produce satisfactory *results*. You leave the responsibility for its mechanical construction to our experience—forget that there are gears and mechanical parts in the car Just rest in comfort and enjoy your ride with absolute confidence in your car.

You can buy over telephone

NATIONAL owners buy performance and not specifications—they can buy their new *Nationals* over the telephone. We sell our experience, ability, responsibility and our guarantee—not a mere job of wheels, axles, gears and parts. That's why you don't have to raise the hood to buy a *National*, you know no better is made.

Lavish in comfort

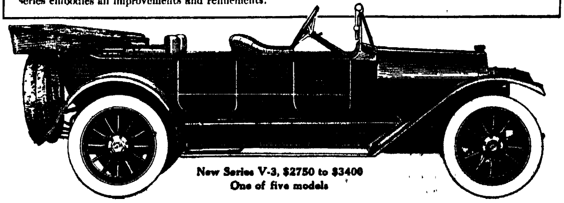
THIS new *National* embodies all our internationally recognized principles of superiority. Beautiful, economical, efficient and lavish in comfort — this car is the climax of the *National's* success in car building since its pioneer beginning. It marks a most coveted improvement in motor car designing. It is the one car that harmonizes from end to end—a symmetrical creation that is distinctive and essentially practical.



REMEMBER

When you say "*National*" you are talking about the world's champion car. The *National* is the World's Stock Champion; International Champion 500-mile race record holder; Fastest Mile for stock car record holder, etc. No other has ever equalled the *National* in actual performance and demonstration of its quality, power, speed, reliability and sureness.

The *National* 40 with its marvelous history, needs no introduction. This is our staple car—the highest achievement in automobile building. Here is the best all-around motor car ever made. This is the third year for this successful car in all its essential features. This new series embodies all improvements and refinements.



New Series V-3, $2750 to $3400
One of five models

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Gentlemen: Without obligation on my part, send me complete particulars of *National* cars.

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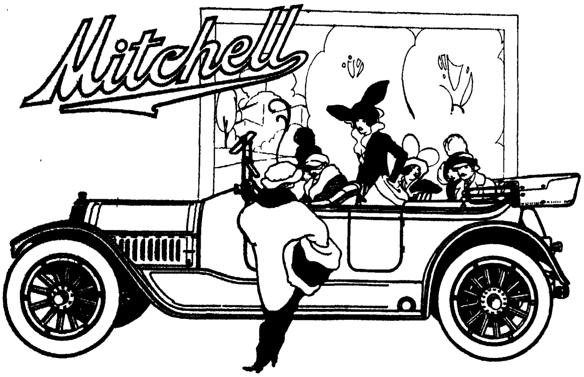
Address ____________________

National Motor Vehicle Co.
Indianapolis, Ind., U.S.A.



Mitchell Sixes

Products of Long Experience

This company has been building popular priced sixes longer than any other concern in this country. Hence the sixes we offer are the product of many years of experience and in no sense experiments.

The *Mitchell Little Six,* which was known as the "Baby Six" in 1912, is, in our opinion, the most logical investment in the automobile market. It is not only the sensible compromise between big and little power and passenger capacity, but it has everything that any high-priced car can offer you.

It has quality that insures long life. It has the style of beauty that the exacting mind demands. It has as much speed and power as any person can desire. It will hold its place in any company and look classy and work perfectly for several years to come. Its equipment is complete, and details thereof sterling in character. The price, $1,895, brings this smart car to you ready for instant use. There is nothing left for you to buy—no extras—no appurtenances.

The *Mitchell Big Six* is the largest and best car at the price that has ever been produced. It is built along the same lines as the Little Six, save that it has 144-inch wheel base, somewhat larger tires, greater passenger capacity. Yet the quality of the two are identical. The equipment is precisely the same—the outward beauty similar. For a big family car the Big Six has no equal in America and there is nothing as good for less than $3,500 or $4,000. The price of the Mitchell Big Six is only $2,350.

The *Mitchell Four* is intended for those who feel that they cannot afford either of the Sixes. It is the only four-cylinder car we make. We build it to meet the demand of those persons who still like a four-cylinder car of class at a popular price. It has the same equipment as the other two cars and sells for $1,595. We want you to look this car over minutely and then ask yourself if there is a four-cylinder car at anywhere near the price that can compare with this one in any detail.

Here is the Equipment for all the Mitchell Models Which is Included in the List Prices, as Given:

Electric self-starter and generator—electric lights—electric horn—electric magnetic exploring lamp—mohair top and dust cover—Tungsten valves—Jiffy-quick-action side curtains—quick-action two-piece rain vision wind shield—demountable rims with one extra—speedometer—double extra tire carrier—Bair bow holders—license plate bracket—pump—jack—and complete set of first-class tools

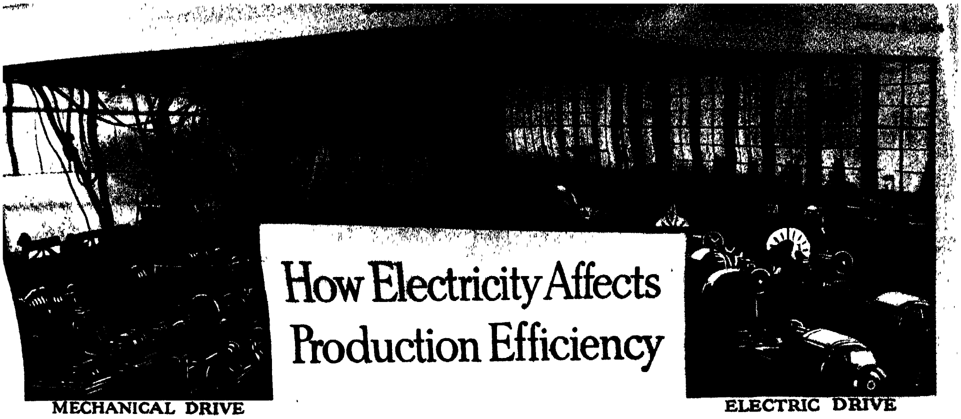
Specifications of the Three Great Mitchell Models:

MITCHELL LITTLE SIX—Fifty horse-power—132-inch wheel base—36x4½-in. tires—two or five passenger capacity	**$1,895**
MITCHELL BIG SIX—Sixty horse-power—144-inch wheel base—37x5-in. tires—seven passenger capacity - - -	**$2,350**
MITCHELL FOUR—Forty horse-power—120-inch wheel base—4 cylinders—36x4½ in. tires—2 or 5 passenger capacity	**$1,595**

ALL PRICES F. O. B. RACINE, WIS.

Mitchell-Lewis Motor Co.
Racine, Wis. U.S.A.

Eighty Years of Faithful Service to the American Public



How Electricity Affects Production Efficiency

MECHANICAL DRIVE

ELECTRIC DRIVE

WHEN the big belt at the end of a long line of shafting snapped with a disagreeable report, throwing a half dozen machines out of commission, the manager of the busy Indiana manufacturing plant turned to the Vice President of the corporation with an exclamation of disgust.

"These things always happen on the wrong day," he said.

The Vice President rather unexpectedly smiled. "Maybe it happens just at the right time," was his comment as he left the place. In ten minutes he was back with the President.

"What you see here," he said to the President with a glance at the halted work, "illustrates better than an hour of talk the immediate need of this concern. The board was satisfied to get in that Curtis turbine and every one agrees that the new electric power was a big thing for the works, but we're away out of date on the rest of the equipment. You know what the line shafting costs. You know that the power loss in transmission is somewhere between 25% and 40%. You know how the whole contrivance of line shafting cuts out light, how dirty it is, how badly it effects insurance rates and how dangerous it is. We're none of us likely to forget that accident to Wincher in September. You know that we're paying for all this wear and tear and wasted power even when only a few of the machines are in use. This morning we have a good, clear showing of what happens to this whole bunch of machines when anything goes wrong with the belting."

"How would you fix it?" demanded the President.

"I'd settle the difficulty by cleaning out the whole mess of shafting and giving individual motor drive to each machine. Then only the active machines would be using power, and the stopping of one would not interfere with any of the others. Now we have to start up the whole of a wasteful and dangerous transmission system to move one machine. With individual drive each machine is independent, and a wide margin of waste is cut out every day. Into the bargain the output would be boosted, man for man, by the modern system. I'm no technical expert, but I should say we were bound to do from 15% to 20% more work with the same force, not counting the salary saving from the simpler machinery system."

As the thing turned out that accident had happened at exactly the right time. The next board meeting took up the problem and a local electrical engineer's figures showed that motors and installation would figure much below the theoretical cost. The actual showing fourteen months after the installation was that the saved percentage more than covered the cost of the change, with an outlook of certain results in economy, while the increase in output quite justified the Vice President's prediction.

In small plants and in large plants, from coast to coast, the newer, cleaner, safer electrical methods are transforming the production problem; first, by improving the physical conditions of plants in the matter of light, by eliminating cumbersome and wasteful transmission machinery, by economies in actual power consumption per machine unit; second, by increasing the working efficiency of each machine unit and each human unit. In refinery or in machine shop, in mill or in printing plant — in any place where power is used; the efficiency and economy of electrical methods are being proved.

Whatever your problem may be, however large or small, it will pay you, in saved money and saved effort, to consider electrical help.

Take up the matter today with your electric power and light company or any General Electric Company agent in your vicinity. You will find them more than glad to co-operate with you, and no matter how complex your problem may be they have at their command the service of any part of our organization that may be most useful to them and to you.

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Trade Mark

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Largest Electrical Manufacturer in the World

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SEVENTIETH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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Edmund Beecher Wilson

The New President of the American Association for the Advancement of Science

By Marcus Benjamin, Ph.D.

IT is now eight years since the American Association for the Advancement of Science turned its steps southward for its annual meeting. Then it met in New Orleans under the presidency of Calvin M. Woodward, eminent for his educational work in the technical department of Washington University in St. Louis. This year it meets in Atlanta with Edmund B. Wilson, who holds the Da Costa chair of zoology in Columbia University, as its presiding officer.

Edmund Beecher Wilson is the son of Judge Isaac G. Wilson and Caroline Clark Wilson, and was born in Geneva, Ill., on October 19th, 1856.

After the usual preliminary schooling he was prepared for college and studied for a year each at Antioch and Chicago; then entering Yale he was graduated at the Sheffield Scientific School in 1878 with the degree of Ph.B. A country boy, he early developed a fondness for nature, the study of which has been the dominant influence of his life. Choosing biology therefore as the subject to which he determined to devote his career, he went to the Johns Hopkins, where under the influence of such inspiring teachers as Newell Martin and Brooks he spent three years, taking the degree of Ph.D. in 1882. A year abroad followed, during which he studied in the laboratories in Cambridge, and Leipsig, and also at the Naples Zoological Station under the famous Dorhn.

On his return to the United States he entered on his vocation as a teacher and lectured on biology at Williams College during 1883-'4 and at the Massachusetts Institute of Technology during 1884-'5. He then accepted an invitation to Bryn Mawr College, where he filled the chair of biology. In 1891 he was called to Columbia as adjunct professor of biology, and three years later was advanced to the full possession of the chair of invertebrate zoology, created for him, which he then held until 1897, when he was transferred to the Da Costa chair of zoology. He also served as member of the University Council at Columbia during 1901-03, and as dean of the faculty of pure science for the years 1905-06.

Wilson's primary interests have always been in the field of embryology and his original investigations which were begun at Johns Hopkins University have been connected chiefly with the study of animals as living things. At first his researches were concentrated on germ cells and directed attention to the study of the laws of normal development from the standpoint of the cell. These he followed with valuable contributions to problems of mosaic development, prelocalization, and differentiation in the egg. Returning more recently to the mechanism of the cell, his researches on the structure of protoplasm, on the history of centrosome, aster and karokinetic figures, and on the chromosomes with special reference to questions of heredity and sex, have occupied his attention.

His many papers, which according to competent authority have had "a wonderfully stimulating effect on biological research throughout the world," have been carefully worked up into harmonious relations with the modern aspects of the fundamental problems of biology, and were given to the world in 1896 in book form with the title "The Cell in Development and Inheritance," which his colleague, Prof. Gary N. Calkins, refers to as "one of the most widely read of modern technical scientific works."

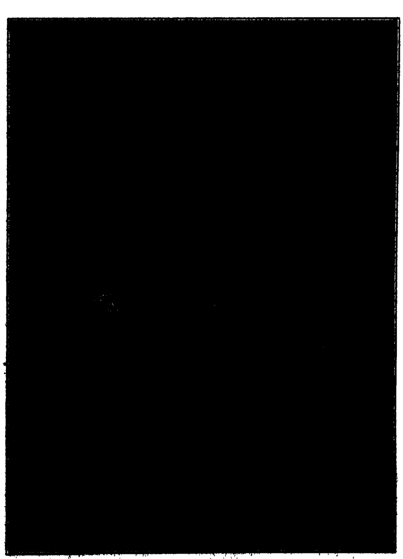
In addition to the foregoing he is the author of addresses and of various minor works in zoology, embryology, and cellular biology. His contributions in book form include (with William T. Sedgwick) "General Biology" (1887); and an "Atlas of Karyokinesis and Fertilization" (1895).

His brilliant researches early gained recognition for him and academic honors have been gladly conferred on him. In this country the three universities at which he studied, Chicago (1901), Yale (1901), and Johns Hopkins (1902) have given him the degree of LL.D., while abroad he has received the degree of Sc.D. from Cambridge (1909) and that of M.D. from Leipzig (1909).

In addition to membership in the American Society of Naturalists, the American Society of Zoologists and the Society of Experimental Biology and Medicine, he is an officer of the New York Academy of Science, a fellow of the American Academy of Arts and Sciences, and since 1899 a member of the National Academy of Science. He holds honorary membership abroad in the academies of science in Holland, Belgium, Bavaria, and Rome (dei Lincei) and also of the Linnean and Royal Microscopical societies.

His connection with the American Association began with his election to membership at the second New York meeting in 1900, at the close of which he was advanced to the grade of Fellow. He affiliated with the section on Zoology, becoming its presiding officer in 1907, when he delivered an address on "Recent Researches on the Determination and Heredity of Sex."

In its selection for a presiding officer for the Atlanta meeting the American Association for the Advancement of Science is indeed most fortunate. Seldom has a more ideal choice been made, for Wilson by right follows in succession to that splendid group of men who from Agassiz and Dana to Cope and Jordan, have been the glory of American science.



Edmund Beecher Wilson, president of the American Association for the Advancement of Science.

Prolonging the Life of Steel

EXHAUSTIVE research experiments have lately been carried out to try if possible to lengthen the life of iron and steel. These experiments consist in the addition of some other metal or chemical element to the iron during the smelting to form an alloy; such elements for example as copper, silver, lead, manganese, silicon, arsenic, aluminium, nickel and tin being added. The more common method of preserving steel structures has consisted in the application of a protective coating of paint or galvan to the steel, the coating acting as an excluder of air and water, and by this means preventing the rusting of the iron indefinitely.

It is remarkable that the addition of certain elements to iron makes the resulting alloy rust and decay more quickly than pure iron. Silicon is a good example of this kind of reaction; if three pounds of silicon be alloyed with nine hundred and ninety-seven pounds of iron, the alloy will rust twenty per cent more rapidly than the pure iron.

The general results of alloying steel with the other metal show that copper and nickel are the best metals to add to the steel to give increased durability. Nickel is prohibitive on account of its price for general commercial uses.

Copper added in small quantities greatly prolongs the life of iron. Very small quantities are needed to effect this result. If to one thousand pounds of iron, two pounds of copper be added, the resulting alloy will dissolve away in acid only one tenth as fast as pure iron does. And in the atmosphere the corrosion will be only one third as rapid. An increase in the copper up to seven per cent of the alloy does not increase the power of the iron to resist corrosion Two tenths of one per cent of copper will yield as good an alloy for resisting rust and corrosion as does seven per cent, and the resulting alloy is less expensive on account of the small amount of copper required

The durability of this alloy has been demonstrated by some very beautiful experiments, performed in Pittsburgh, Pennsylvania, by Mr. D. M. Buck, and by Prof. C. E. Burgess and J Aston of Wisconsin University.

Mr. Buck's experiments were carried out in a practical way by erecting sample roofs made of pure iron and others made of the alloy containing two tenths of one per cent of copper. These sample roofs were distributed both in the city in the region of the coke ovens and in the rural districts around Pittsburgh, and the rate of corrosion was noted carefully and the time recorded The copper alloy roofs were in good condition when the pure iron had completely corroded and had fallen away. The results show also that the metals are less attacked in the rural districts than in the city. This is to be expected and is no doubt due to the carbon and acid fumes present in the city atmosphere.

The experiments carried out at the University of Wisconsin were not carried out on so large a scale as Mr. Buck's, but they confirm very clearly his results Their experiments show that the addition of many metals, such as silver, which in themselves are too expensive for general use, have the same effect as small quantities of copper in prolonging the life of steel.

Their results also show that no very reliable data can be obtained by the accelerated acid test which will indicate the possible length of life for the steel under ordinary weather conditions.

An Echo of the Hubbard Expedition to Labrador

DILLON WALLACE, whose book "The Lure of the Labrador Wild" is a record of the adventures of himself and Leonidas Hubbard, Jr., during their exploration of the interior of Labrador in 1903, in which Hubbard died from starvation and exhaustion and the author narrowly escaped the same fate, has just returned from a second hazardous journey to the same region The purpose of this trp was no less sentimental than that carried out in 1905 by Mr. Hubbard's widow, who, besides continuing her husband's explorations, proved to the world the feasibility of his projected route. Wallace revisited the headwaters of the Susan River, discovered during the original expedition, in order to erect a bronze tablet at the place where Hubbard died. Unluckily the tablet was lost from his canoe *en route*, and Wallace accordingly carved his comrade's epitaph on a rock.

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The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement

Retrospect of the Year 1913

Civil Engineering.

A RETROSPECTIVE view of the field of civil engineering, especially if it be taken from the American standpoint, brings to mind, at once, the Panama Canal the greatest civil engineering work of all time. In the annals of the canal the year 1913 will be memorable as having witnessed its practical completion During the first nine months of the year Gatun Lake was filling with water, on October 10th President Wilson threw an electric switch and blew up the Gamboa Dike admitting the water to the Culebra cut, and a few weeks previously a dike at Miraflores was blown up, admitting the Pacific waters to Miraflores locks A heavy force of hydraulic dredges has cut through the Culebra slides and is now engaged in clearing up the canal prism at the cut On September 26th a Government tugboat made the first passage of Gatun Locks Subsequently, whole fleets of dredges and their accessories made the passage both of the Gatun and the Miraflores and Pedro Miguel locks. Early in 1914 the canal will be in such shape that, if it were desired, the largest ship in the world could be sent through from ocean to ocean The formal opening will take place in January, 1915, when a vast international fleet, headed by the old battleship "Oregon," will make the transit from ocean to ocean It was a great feat to build any kind of a canal at Panama—to build a canal of this magnitude and complete the job, in spite of 30,000,000 yards of unlooked for excavation, due to slides, etc, one year ahead of the specified time, is a magnificent performance. The past year has been one of great progress on the New York State Barge Canal, and it looks as though within about two years' time it will be possible for 1,000-ton barges to pass between the Great Lakes and the Atlantic by way of the Hudson River. A most important waterway and a competitor of the State Barge Canal is the St Lawrence Ship Channel, between Montreal and Quebec, a distance of two hundred and twenty miles Here the Canadian government is rushing work upon a 35 foot channel A depth of thirty feet has already been obtained over this distance The Cape Cod Canal, 25 feet deep, 150 feet wide and 13 miles long from Buzzards Bay to Bonstable Bay, will be opened in June, 1914 This waterway will render available for 25,000,000 tons of shipping annually a safe inside route, as against the dangers of the outside route through Vineyard Haven Sound and around Cape Cod The vast scheme for bringing the Catskill Mountain water to New York has made great progress during the year The Ashokan dam has been completed, the greater part of the 92-mile acqueduct is built, the water being now available for discharge into Croton Lake, and excellent progress has been made upon the deep distributing tunnel beneath New York, which, in places, reaches a depth of over 750 feet The New York system of dual subways, another vast engineering work, has been pushed so vigorously during the year that two or three of the main sections will soon be in operation or within measurable distance of opening This work will practically treble the existing facilities, and the probabilities are that, within three or four years' time, a greater part of the system will be in active operation. After six years of labor, the enlargement of the Assuan dam on the Nile, Egypt, has been finished The dam, which is 1.21 miles in length, has been raised 16.6 feet in height and increased in thickness by about sixteen feet, and thereby the volume of water stored has been increased from 35,300,000,000 to over 81,000,000,000 cubic feet. The benefits conferred upon Egypt by irrigation are to be repeated beyond the Red Sea in Mesopotamia, where the engineer who is mainly responsible for the Egyptian improvements is now developing and constructing a system of irrigation which promises to restore to that storied land much of its one time fruitfulness and prosperity. The great works of irrigation being carried by the United States Government in the West and the Middle West have, one by one, been completed, and when some adjustment of the rates and time of payment have been made, there is no question that the full predicted benefits of this great work will be realized. Next to the Panama Canal, the engineering work which has attracted greatest attention in this country during the year has been that of the control of the Mississippi River. The devastating floods have merely served to prove that the regulation of this river can be secured only when the whole co-ordinated scheme of revetment and levees, as planned by our army engineers, has been completed. If the staff and the large working plant at Panama were removed to the Mississippi Valley and the whole job placed under one-man control, and the necessary funds made available, the problem of the Mississippi Valley would be easy of solution

Naval and Military.

The opening of the year 1914 finds the United States in the humiliating position of a third-rate naval power—third rate in so far as the strength of its first fighting line is concerned This is due to two things. First, the revolution in naval rating which has been brought about by the advent of the "dreadnought," and second, the disposition of congressmen to play politics with naval policies and cut down national in favor of local appropriations. There is one first-rate power—Great Britain with forty-two dreadnoughts built and building; there is one second rate power—Germany, with twenty-six such ships built and building; there are three third rate powers—the United States, France, and Japan, respectively, with 12, 11 and 10 dreadnoughts built and building. If we rank third-class in material there is some consolation in knowing that we rank absolutely first-class in the high quality of the officers and men of our navy Moreover, such dreadnoughts as we possess are fully the equal, ton for ton of displacement, of any ships in the world. With the exception of the British navy, which has more than doubled the accuracy of its fire by the introduction of the fire-director system of Sir Percy Scott, our shooting is believed to be as good as that of the other leading navies. Let us take such comfort from this belief as we may—the disquieting fact remains that in ships of the line we are third-rate, and in shortage of torpedoes at the very bottom of the list! There has been a steady increase in the size of ships and the guns they carry. Great Britain has gone up to 28,000 tons, Germany to 26,000 tons, and we have two ships on hand, the "Pennsylvania" and her sister, which are of from 31,000 to 32,000 tons displacement. The multiple-gun turret finds increasing favor The United States is placing the three-gun turret on the "Nevada" and "Pennsylvania" classes. Italy has already put in commission her first three-gun turret ship, the "Dante Alighieri." Russia and Austria are using the same turret; but England, Germany, and Japan are holding back; apparently, they still believe that two guns in a single turret is the maximum number that can be used to full efficiency. France, on the other hand, is building several dreadnoughts which mount twelve guns in three four-gun turrets; and the French, by the way, are exceedingly clever and successful in their designs of ordnance. The multiple-gun turret greatly assists the spotter; simplifies fire control; and secures a very considerable reduction in weights. Certainly the most remarkable ships of the year are the five British battleships of the "Queen Elizabeth" class, whose contract speed is to be 25 knots, and their armament eight 15-inch guns. The builders of the turbines assure us that they look for 27 knots in these ships. Meanwhile our own navy sticks to 21 knots as a maximum speed. Which is right? Time alone can tell. England, Germany, and Japan are still building battle-cruisers with speeds of 28 to 30 knots. Japan will soon have four of these ships, carrying among them thirty-two 14-inch guns, afloat on the Pacific. In the event of war they will constitute a knotty problem for our Board of Naval Strategy at Washington. An interesting development has been the launching by Great Britain of a "destroyer of destroyers," as she was called by the First Lord, a ship of 3,500 tons and 30 knots speed. On the other hand, the Germans have built for Russia a destroyer, the "Novik," which made 37 knots on trial, and 36.2 knots for six hours of that trial—and so it goes. Altogether, the year 1913 must be considered as finding the naval-diplomatic situation as regards this country in a critical condition; with its navy sunk to the third-rate rank, at a time when the administration is adopting a policy with regard to neighboring States, which, for audacity and grave portent, has never been equaled in the history of the country.

The Merchant Marine.

Judged from the standpoint of construction, the two outstanding features of the past year are, the continuous increase in the size of ocean steamships and the great amount of thought, labor, and expense, which have been devoted to finding the best type of motive power. Last year was notable in the annals of the merchant marine as witnessing the advent of the first 900-foot ship, the "Imperator" which is 909 feet in length, 98 feet in beam, and displaces, at maximum draught, some 58,000 tons. The present indications are that the big ships of the future of her class will be of moderate speed, say 23 knots, this being the assigned speed of the new "Aquitania," 901 feet in length, which will enter this port during the summer of this year, flying the Cunard flag. The year witnessed the launch of the "Vaterland," sister to the "Imperator," 940 feet in length, and the laying down of another ship of similar dimensions. The application of the Diesel engine to marine propulsion has made steady strides during the year. The "Hagen," propelled by Diesel engines of 2,300 horse-power, made a very successful maiden voyage to this port, and later there came the "Wotan," a large tank steamer 404 feet in length, and capable of carrying 7,680 tons of oil, which is driven by Carels-Diesel engine of 2,900 horse-power (steam engine rating). The builders of this engine have such confidence in its reliability that they have put the whole of the power into a single engine driving a single propeller. During a recent test before marine engineers and representatives of the technical press in this city, this big unit, the largest Diesel marine engine yet built, was run at maximum revolutions with a remarkable absence of vibration, and the reversing from full speed ahead to full speed astern was done in eight to ten seconds, a truly wonderful performance. Rivaling the Diesel engine in its interest is the marine transformer or transmitter, designed in its various forms to reconcile the high speed demands of the turbine with the low speed demands of the propeller, if both are to secure their highest efficiency. In this country, the Westinghouse helicoidal mechanical gear has shown an efficiency of something over 98 per cent, and it has been fitted on the collier "Neptune" of 19,300 tons displacement. In addition to the steam economy due to the use of high-speed turbines, its introduction would secure a great saving in weight, both in the engine and the boiler plant. These are the economies aimed at in all transmission gears. The "Jupiter," sister to the "Neptune," has been fitted with an electrical reduction gear, consisting of a generator delivering current to motors on the propeller shafts. This ship is now undergoing trial. Parsons, in England, has fitted mechanical reduction gears to several cross channel steamers and large economies have been secured. The German Foettinger gear was submitted to a 14-day test at the Vulcan Works, at loads of from five thousand to ten thousand horse-power, during which an efficiency of 90 per cent was secured; and this gear is being installed on several large German steamships. There was completed for the Great Lakes service in November of this year at Wallsend-on-Tyne, England, the "Tynemount," a freighter of 2,400 tons capacity, which has a most interesting drive, consisting of two six-cylinder Diesel engines direct connected to three-phase generators, which furnish electric power for an induction motor mounted directly on the propeller shaft. This is the first large commercial ship to carry an electric reduction drive, and its performance will be watched with keen interest. The "Titanic" disaster has resulted in the formation of an international committee which is now sitting in London to determine the question of interior safety construction for ships, the number and character of lifeboats they shall carry, and the various protective devices, in the way of wireless telegraphy and other apparatus, designed to protect the life of the passenger at sea. There is no question that the whole subject will be most thoroughly and conscientiously thrashed out at this conference, and an entire revision and improvement of existing rules will be secured.

Electrical Engineering.

Although its inception was prior to 1913, the active work of the recently organized Society of Electrical Development falls within the past year, and marks one of its most important outgrowths. The object of this society is to introduce electricity more widely, and to infuse a new spirit of co-operation in the business of selling electricity and electrical goods. Probably the most promising electrical event of the year is the development of the nitrogen lamp. This is a tungsten lamp filled with nitrogen gas, in which the filament may be heated to a much higher temperature. In the large units of 4,000 candle-power and over it shows an efficiency of 0.4 to 0.5 watt per candle-power. Smaller units using 10 amperes at 4 or 8 volts give an efficiency of 0.6 to 1, or even 1.25 watts per candle. Lamps for the standard 110-volt circuit will produce a thousand candle-power and over at 0.5 watts per candle. It is found difficult to produce nitrogen lamps in smaller units owing to the cooling effect of convection currents in the gas. The lamp produces a light that is closer to daylight than any other except the Moore tube filled with carbon dioxide. Other developments in lighting are the Cadmium lamp, which is similar to the mercury vapor lamp, except that cadmium is used instead, to produce a light similar to daylight, and the so-called "cold" light for stereopticon and kinetoscope work. It consists of a series of tungsten lamps which are successively lighted with current at super-voltage, giving flashes of intensely white light that come with such frequency as to give one the impression of a continuous light. Thus, while the heat effect of the electric current is dissipated over a great area, the luminous rays are concentrated in a very small point of space. The use of electricity on the farm for light and power is steadily increasing. Much has been done with intensive culture, not only under the direct influence of electricity, but indirectly by the use of electric pumps for irrigating purposes. In England experiments have been made to determine the influence of high frequency currents upon the growth of chickens, and the results are truly astonishing. Chickens living in the electrified zone in five weeks reached the weight of normal chickens of three months. Because it is a young branch of electrical engineering, there is a great deal to be said annually about the progress of wireless telegraphy. Early in the year communication was established for the first time directly between Germany and the United States. Several new stations have been built or are building for transatlantic wireless service. During the fall wireless telegraphy gave us another demonstration of its importance to navigation, when the "Volturno," afire and fearing immediate destruction in a storm, summoned a rescue fleet by wireless telegraphy, which arrived in time to save a large part of the crew and passengers. To aid the mariner in finding his way across the ocean, wireless signals are sent out daily from the Eiffel Tower in France and from the Arlington station in this country. Wireless telegraphy is being used on trains to permit of communication with stations along the line. Wireless or induction train signal systems are being tried out on some lines. Considerable progress has also been shown in wireless telephony. Spoken messages were sent 600 miles from Rome to Tripoli. At this late date it seems remarkable that material progress should have been made in telegraph and cable systems. During the year a system has been devised which permits of sending the regular dot and dash signals over cable lines and relaying them automatically over land lines. Railroad electrification also shows material progress. For instance, the Chicago, Milwaukee and Puget Sound Line is electrifying 450 miles of its main line between Harlowtown, Montana, and Avery, Idaho. The Norfolk and Western Railroad is electrifying the Bluefield Vivian section, 85 miles long, over which sixty-five thousand tons of coal are handled daily. The Pennsylvania Railroad has announced that it will extend its electrified zone from New York to Elizabeth, and this is probably but a step toward electrification all the way from New York to Philadelphia. Recently a commission appointed by the city of Melbourne, Australia, to determine the best system for its suburban railways, covering about 300 hundred miles of steam and railroad tracks, reported that the direct current system showed a material advantage over single-phase alternating in first cost and also in the annual cost of operation.

Astronomy.

By far the most important astronomical announcement of the year came from Prof. George E. Hale, director of the Mount Wilson Solar Observatory. It will be remembered that some years ago Prof. Hale discovered the Zeemann effect in sun spots, thereby conclusively proving that sun spots must rotate and establishing a field of magnetic influence on the sun. Even more important was the later discovery to which we refer which is nothing more or less than the fact that the entire sun may be regarded as a rapidly rotating magnet.

It has long been known that the conspicuous star cluster in the Pleiades is accompanied by faint nebulosities. Until the work of Mr. Slipher at the Lowell Observatory, nothing was known of the real nature of these faint clouds of light. Very long exposures revealed to Mr. Slipher a distinct spectrum quite different in character from that of any previously known nebula. He showed that the brighter parts of the nebulosity of the Pleiades shine with light which is exactly similar in spectroscopic character to that of the brighter stars of the cluster. It is supposed accordingly that the nebulosity in the Pleiades consists of opaque matter, perhaps of meteorites or fine dust which accompanies the stars of the cluster and shines by their reflected light.

On the night of August 13th, 1911, the third satellite of Jupiter, Ganymede, passed directly in front of a star of the seventh magnitude in the constellation Virgo, and for observers in the southern part of the earth, actually hid the star for more than four minutes. The circumstances of this remarkable occultation were carefully calculated in advance by Banachiewicz. It appeared that the best observing stations would be in South America. Dr. Ristenpart, a German astronomer of distinction, set about the organization of observers throughout Chile. Ganymede is much smaller than the earth, and its shadow is only a little more than four thousand miles in diameter. As Jupiter and its satellite moved, this "shadow" crossed the earth, its center, passing over the southern extremity of South America, a little north of the Straits of Magellan, while its northern limit reached barely to the boundary between Chile and Peru. By comparison of the duration of the occultation as seen from different places, it was possible to obtain very accurate information regarding the size and shape of the eclipsing body. On the basis of the many visual observations made under Dr. Ristenpart's direction, it seems necessary to assume that the satellite like Jupiter itself is flattened at the poles; for otherwise the calculated length of the occultation at the northernmost station, where the star appeared to pass just inside the satellite's disk, should have been much longer than the observed time. Dr. Ristenpart concluded that the equatorial diameter of the satellite is four thousand seven hundred miles and the polar diameter four thousand three hundred miles, so that it is a little more flattened in proportion to its size than Jupiter itself.

Comets are no longer the astronomical curiosities they once were. Three or four are discovered with the aid of the telescope or the camera every year, and 1913 proved no exception. The principal comets were those of Schaumasse, discovered on May 7th at Nice; Metcalf, discovered on September 1st; Neujmin, discovered on September 5th; Delavan, discovered on September 26th and recognized as a return of Westphal's comet of 1852; Tinner, discovered on October 23rd and identified as a return of the third comet of 1900; Delavan, mentioned on another page.

Steam Railroads.

So far as America is concerned, development in steam railroads during the past year have been strictly along those lines which during the past two or three decades have been strongly characteristic of American railroad practice. To-day, we are carrying freight, not only at a much lower rate per ton per mile than any railroad in the world, but even at a lower rate than similar freight is carried for the same distance on the cheap waterway transportation systems of Germany. This result is largely due to our greatly increasing the size of the individual train unit. Locomotives have grown to be several hundred tons in weight; fifty tons has become the standard freight car capacity, and cars of seventy-five and even one hundred tons are in the making or are seriously proposed. The matter of better rails is still a burning question, to which both the railroads and the manufacturers are giving closer attention than they are perhaps to any other product in the heavy manufactured steel trade. The future promise of the railroads getting absolutely reliable rails that will stand up under winter and spring service, lies in the new electric steel making process, which the United States Steel Corporation is trying out on an extensive scale, as explained and illustrated in our issue of June 7th, 1913. The advantage of the electric over the Bessemer and basic Open-Hearth processes are that it secures a more complete removal of oxygen; an absence of oxides; an absence of segregation; the practically total elimination of sulphur and phosphorous—with the result that a very reliable rail is secured. In this connection, it should be noted that, during the year, there has been a wonderful growth of the "Safety First" movement, the importance of which has come to be thoroughly appreciated, not merely by the management, but by the employees. The disastrous wrecks on the New Haven Railroad, to which we gave so critical attention in 1912, were followed by other wrecks in such quick succession, as to convince the nation at large and Congress in particular, that legislation was necessary. The Interstate Commerce Commission is being given the necessary legal status to enable it, not merely to advise, but enforce its recommendations—a wise provision if the delegated authority be exercised with discretion. The automatic stop, thanks largely to the New Haven disasters, has been thrust into the prominence which it merits, and many of the keenest minds, both expert and lay, are being devoted to the production of a stop which shall be thoroughly practicable. That it is the finest safety device ever devised for the protection of railway travelers is proved by the record of the Interborough Railroad where, during several years of operation on express trains, under a headway of one minute and forty-three seconds, there has been only one failure out of 277,846 movements. In locomotive construction, the noticeable developments have been the increased use of superheaters and the tendency to regard the simple, superheated locomotive as the best all-round machine for future use. Great interest was aroused by the production of the first Diesel-engine locomotive, a powerful engine, built for express service, containing a driving engine coupled to the driving axles, and an auxiliary engine working independently of these. The trials are now being carried out, and we understand that the engine has fulfilled all expectations as to its hauling ability. It is too early, however, to make any definite statement as to the permanent usefulness of this type With the increasing size of the locomotive has come a corresponding demand for mechanical stoking, the work of feeding the fuel to the huge modern boilers being more than one man can accomplish. Several types are being tried and in some cases good results have been secured Undoubtedly mechanical stoking has come to stay

Aviation.

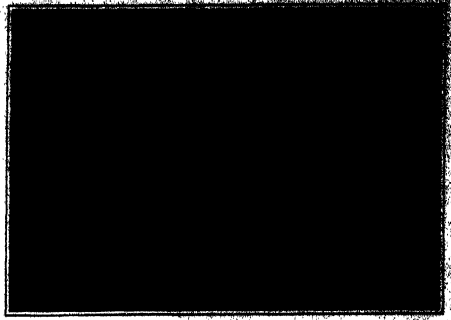
A broad view of the field of aviation during the past twelve months reveals two most important directions in which more than any others, notable progress has been made. These are endurance and stability Particularly in cross-country flying have both the aeroplane and the dirigible established their endurance and reliability. Witness the feat of Brindejonc des Moulinais, who, in exceedingly stormy weather, flew from Paris to Warsaw in 10 hours and 12 minutes, with but two stops, at an average speed of 91 47 miles an hour. Or consider the feat of Stoeffler who, flying to and fro across Germany, as though the whole Empire were but an aerodrome, covered in 24 hours a distance of 1,350 miles at an average speed of 56 miles an hour. Then turn to the Riviera and see Garros taking wing over the Mediterranean for the coast of Africa, with such supreme confidence in his motor that he stripped the pontoons from his hydro-aeroplane, and, with the machine as thus lightened, covered 550 miles or more in a continuous flight of nearly eight hours, landing safely on the African coast. For records of speed we look naturally to the Gordon Bennett cup annual contest Last year the French won it at an average speed of 105 5 miles an hour. This year it was won in France by a Deperdussin, torpedo-body, monoplane, whose 160 horse-power Gnôme motor drove the machine around the course at an average speed of 124 77 miles an hour Far surpassing this, however, was the feat of the Frenchman, Gilbert, who, on the last day of October, won the Pommery cup by flying from Paris to Puertniz, Pomerania, a distance of 650 miles, at an average speed of slightly over 124 miles an hour The height record was won by Perreyon in a 160 horse-power Blériot, who rose above the earth to a height of 19,685 feet, or about three and three fourths miles Von Blaschke carried two passengers with him to a height of 11,740 feet. Passenger-carrying aeroplanes of large capacity are becoming common. The record for size is held by the Sikorsky biplane, which, with 1,358 square feet of surface and 400 horse-power, flew for over an hour with seven passengers and for fifteen minutes with twelve passengers. America gave to aviation the first power-propelled man-carrying aeroplane It contributed also through Curtiss the first practical hydro-aeroplane; and it looks as though to the many triumphs of the flying boat will be added the crowning feat of making the first crossing of the Atlantic A $50,000 prize awaits this accomplishment; and it is possible that the present year will see the inauguration of transatlantic aeroplane flight In spite of many disasters which would have discouraged a less persistent and courageous people, the Germans seem to have unabated confidence in the rigid dirigible The shocking fatalities, twenty-eight in number, which resulted from the total destruction, through explosion, of Germany's latest and finest dirigible, "L. II," have been definitely ascribed to an error which may be easily corrected in future construction. The many disasters are largely offset by the brilliant successes of the dirigible The largest of these had sufficient capacity to cross the Atlantic, and the maximum speed was between 55 and 60 miles an hour. The record of the past year shows that both the aeroplane and the dirigible are destined to find their greatest immediate field of usefulness as an arm both of the military and the naval service, the former for swift reconnaissance for limited periods of time and the latter for more extended observations lasting for many consecutive hours. The sensational feats of Pégoud and others have shown that the aeroplane possesses far greater stability if properly handled than was supposed. To this is to be added the fact that the gyroscope and the swinging pendulum weight have both been utilized successfully for giving to the aeroplane satisfactory automatic stability.

Miscellaneous.

Of the incidents of general interest in the field of science which have taken place within the past year, probably none has attracted such universal attention and feeling as the publication of the history and fate of the Scott Antarctic expedition. We have in due season paid our homage to the heroes who thus perished in the pursuit of science. In the field of anthropology intense discussion has been aroused by the discovery of the Piltdown skull and the divergent con-

(Concluded on page 28.)

A string of ladles run from the cupolas to the molds.



The molds travel in endless procession to the pouring point.

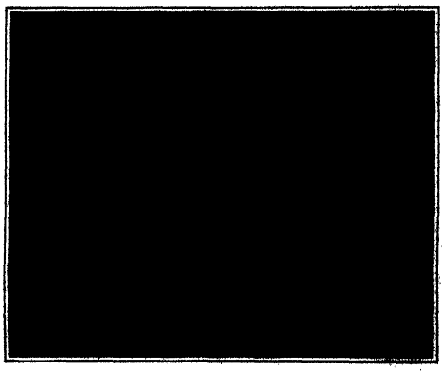
Going Through the Shops—I

The Scientific American's Associate Editor Sees How a Factory Turns Out a Thousand Cars a Day

By A. Russell Bond

YOU may pay five thousand dollars for an automobile or only half a thousand, and, in either case, if your choice has been wise, you will get your full money's worth. Which is to say that widely differing species are classified under the generic term "automobile." The species range from the cars of luxury, models of beauty and power, smooth, quiet running machines, possessed of every latest wrinkle of convenience and whim of design that fashion may dictate, all the way down the list to the humble members at the other extreme, not works of art but of utility, staunch machines, small, but amply powerful for all ordinary purposes and possessed of an amount of "go" that is really astonishing when we consider their exceedingly low cost.

Manifestly, we cannot discuss the manufacture of machines so divergent in one and the same article and, therefore, we shall defer to a later installment the exceedingly interesting processes employed in the building of the more refined product, and take up now the equally interesting story of how the low-priced car is manufactured. Curiously enough, the production of the latter car involves the greater outlay of capital and ingenuity. However, the outlay is manifest not in the machine, but in the plant that builds it. If a motor car is to sell at a low figure, it must necessarily be made in large quantities. Engineers must resort to every mechanical kink and contrivance that will simplify the work and save precious moments.

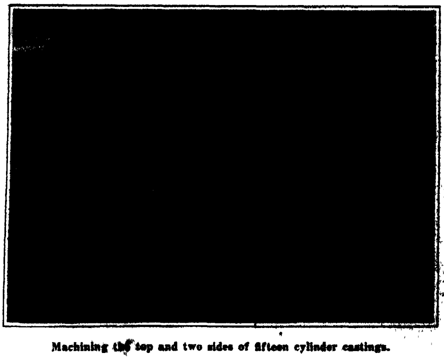


A drill inverted to save time in placing the casting.

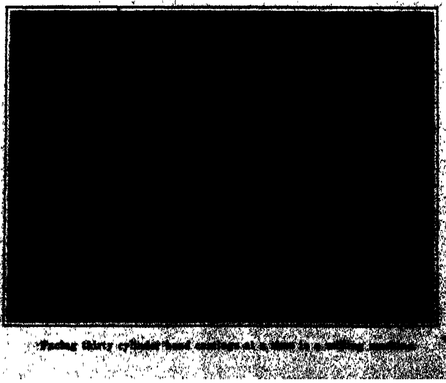
The accompanying photographs will serve to illustrate how system has been carried to an extreme in the manufacture of the small automobile. The pictures were taken in a factory which, during the busy season, turns out a thousand automobiles per day. From the foundry to the assembly department the work has been analyzed to the minutest detail with a view to economizing time. Men are given tasks that are very simple in themselves, and, by dint of repetition day in and day out, acquire a knack that may cut the time of the operation in two. A man may become a specialist in so insignificant an operation, for instance, as putting in a certain bolt in the assembling of the machine.

We have space to illustrate only a few of the apparently infinite stages involved in the building of the car. Starting with the foundry we find a row of cupolas, one of which is always ready to deliver a stream of molten metal. In front of the cupolas overhead is a track of I-beams laid out in a long loop that runs by the molds. Mounted to travel on the lower flanges of the I-beams are carriers from which are suspended large ladles or "shanks" into which the metal is poured. The ladles are then moved along the track until they come to the molds. Here the molten metal is poured into small hand ladles, as required, and with them the molds are filled. In order to have a continuous supply of molds ready to receive the metal, they are mounted on a series of conveyors. Each conveyor consists of an endless chain of carriers similar to those by which the ladles are transported, and running in a loop of overhead track that lies at right angles to the track for the ladles. On the swings suspended from the carriers, the molds are placed. At one end of the loop, the molds are assembled. Thence they progress to the point where they are filled and pass on to the place where they are removed from the conveyor, and replaced by fresh molds.

The resulting castings, after they have had a chance to season for a few days in the open, are carried into the machine shop on an overhead monorail system which is depicted herewith. Each monorail train consists of an operator's car and two hoists capable of lifting two tons each. These trains pass through the factory, constantly transporting the materials over the heads of the workmen and depositing them where required.



Machining the top and two sides of fifteen cylinder castings.



Facing thirty cylinder head castings at a time in a milling machine.

The mono-railroad that carries castings into the machine shop.

Automatic vertical gang lathe for turning down four pistons at once.

This mono-railroad comprises over a mile of track.

In the machine shop let us follow the operations on the cylinder castings as illustrative of the time-saving methods employed. Two of the photographs show how the cylinder castings and the cylinder heads are machined in gangs. Fifteen cylinder heads may be run through the milling machine at a time, having the top and two sides machined at one operation, while in the milling of the cylinder heads, thirty castings may be attached to the table of the miller at once. The castings are all assembled in jigs so that little time is consumed in securing them to the table.

The cylinders are bored out four at a time to within one thirty-second of an inch of their final dimension, after which they are reamed out true to within one one-thousandth of an inch. The cylinders are tested by placing the casting on a standard over an electric light, inserting a plug gage in the bore and noting whether any light passes between the plug and the cylinder walls.

The drilling of bolt holes and the boring of bearings call for the development of special machinery. In one case, namely, that of drilling the main bearing bolt holes in the cylinder casting, the usual operation is inverted; the casting is supported over the drills which feed upward instead of downward. The object of this is to make use of the lower face of the casting as a working base, letting it rest on the drill table, and centering the casting by means of guides which engage the two outer cylinders, thus saving time in securing the work to the machine. There are many such cases in which startling liberties have been taken with the standard machine tool merely to gain a few minutes of valuable time. For instance, there is a toggle press in which the punches move horizontally. Speaking of punch presses, they have even had the audacity to punch holes in iron castings. A malleable iron casting at the forward end of the drive shaft tube has six holes punched in it at a single operation.

In roughing out pistons, a gang-lathe is used which permits four of the castings to be machined at once. Each lathe member completes all the operations on the piston automatically, one tool facing off the head, another chamfering the upper edge, three others cutting the ring grooves, another cutting the relief in the side of the piston, while still another tool finishes the bearing surface of the piston to within a very small fraction of an inch of its final diameter. After the piston has thus been roughed out, it is put on the lathe and a finishing cut brings it to within [illegible] of an inch of the specified diameter.

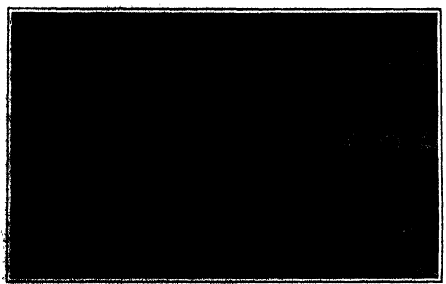
[illegible]

[illegible] in connection with this car is the manufacture of the magneto. In the particular type employed, sixteen magnets are used which are secured to the flywheel of the motor while sixteen double coils are mounted on the frame. This calls for the winding of 82,000 coils and the manufacture of 16,000 permanent magnets per day. The magnets are cut out of stock to the required size, heat treated, bent to U-shape, heat treated again and straightened. Then they are magnetized by merely touching them to the poles of powerful electro-magnets. After they have been magnetized, they are assembled in trays, as shown in one of the photographs, with the north pole of one magnet touching the south pole of the next adjacent magnet, and so on. The field coils are wound in gangs of eight, insulated copper ribbon being the conductor employed. The winding operation is very simple and, as eight coils are produced at a time, it is possible with three or four hand machines to furnish all the coils required.

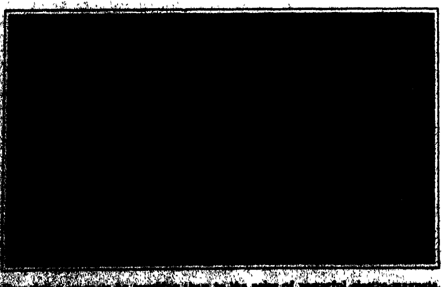
The rear axle of the machine is rather interesting. It consists of two tubes, each of which is flared at one end in a bulldozer and fitted over a bell to which it is welded in an electric welder. Two of these axle sections are put together, the bells forming the housing for the differential. The gears are tested by placing them on an arbor connected with an index needle and turning them in mesh with a master-gear, when the slightest eccentricity will be shown greatly magnified by the needle. Before the rear axle may be assembled in the chassis it is put through a test which consists in running the drive shaft with an electric motor in order to work in the gears. If they make too much noise they are simply discarded and go to the scrap heap. Similarly the motor of the car is tested by running it for a time until its bearings have been eased up.

In the machine shop there are so many machines going at once, such an infinite variety of work being performed, that one emerges from it in a daze. In the assembly department, however, the operations are more readily comprehended, and one is fascinated at the miraculous growth of the machine there before his eyes. An assembled rear axle is laid over a pair of horses, the side frames are added, the front axle applied, the wheels mounted, then it moves on to where the engine is fitted in place; another advance and the dashboard and steering gear are bolted fast; at the next step the radiator is affixed; then the gasoline tank is mounted on the chassis and filled with fuel, and almost before we realize it the completed chassis has reached the end of the line.

It is difficult to start a new engine before all the parts have worked themselves into their bearings, and so the machines are not cranked, but are started by pressing one of the rear wheels against a pair of rapidly revolving pulley wheels in the floor. At the same time, a rubber hose is connected to the exhaust pipe of the engine, so that as soon as the motor does start up, the gases will be carried through the hose to the outside of the building. The chug of the motor is heard. A lever is thrown. Off starts the chassis through the doorway, wrenching itself loose from the exhaust hose. In an instant it has disappeared around the corner in a cloud of smoke. The trial spin ended, it re-


A gang of powerful presses that form the crank case.

Testing the gears of a differential for noise.


Magnetizing magnets by touching them to the poles of powerful electro-magnets.

turns to another point in the plant where a car body comes down an inclined chute from an upper floor and is rapidly clamped to the chassis by specialists in this particular line of work. And lo, a new automobile has been born. But congratulations must be short-lived because another is on the way and due to arrive within less than a minute.

The Car of 1914

As we gaze backward over the stretch of years that commenced with the birth of the automobile, one thing stands out clearly among the mighty improvements that have been made. The six-cylinder car is predominant. From a small beginning it has swept on until in 1914 it has well-nigh carried all before it. It is the prevailing feature of the past automobile year beside which other features pale—but not into insignificance.

The year gone by has seen an unprecedented number of prominent automobile manufacturers proclaim their adherence to "Sixes Exclusively." Others, who, up to the opening of the 1914 season, have looked at the six-cylinder car askance, have been compelled to take it up in self defense. If we delve into figures, it is revealed that the number of makers who produce six-cylinder cars exclusively has increased from an inconspicuous three per cent of a total of twenty-eight well-known makers in 1908 to 34 per cent of forty-two makers in 1914. The figures illuminating the decline of the four-cylinder model are even more impressive. Sixty-four per cent of twenty-eight makers produced four-cylinder cars exclusively in 1908; in 1914, but 12 per cent of forty-two makers will list only four-cylinder models. The percentage of manufacturers producing both four- and six-cylinder models shows equally startling changes. In 1908—only six years ago—one fourth of the twenty-eight makers produced both; in 1914, no less than 54 per cent of forty-two makers will produce both. It is plain that the "six" is the predominating car and that the promise of 1913 in this respect has been more than fulfilled.

It goes without saying that the car of 1914, be it "four" or "six," is a better car—better in a number of respects. But, as was the case last year, the change is largely in details.

Among the more noteworthy features is the manner in which the new season's models have been electrified. In addition to the electric starter and electric illumination we now have the electric gear-shifter and the electrically controlled two-gear drive-axle, both brand new features. That the former bids fair to remain with us is indicated by the fact that not one, but several, well known makers have adopted it, and though there are those who hold to the belief that not more than the mere selection of the gears should be done electrically, leaving the actual shifting to more mechanical means, the opinion is by no means general. The two-gear rear axle would seem to fill a need of the four-cylinder car; for it permits the engine to be operated more nearly at its maximum efficiency under all conditions, and, in a measure, insures that smoothness of action which is a characteristic of the "six" at low speeds.

Electric engine starting and lighting apparatus has advanced, too. The apparatus is lighter now than it has been in the past and therefore is more efficient. There seems to be a tendency toward the utilization of separate units rather than a combined unit for the two functions, although opinion is still largely divided as to which is the better method. At any rate, electric engine starting is now supreme. The demand for it has virtually forced every other type of starter off the market, a fact which is well exemplified by the action of several prominent manufacturers who have used pneumatic starters for years, but who have cast them out for electrical apparatus for their 1914 models. Another feature which is new to the 1914 car is the combination of side and head lamps, a palpable improvement too long deferred.

The silhouette of the 1914 car is changed. In the first place it is slightly lower, which may be expected to affect stability, and there is a marked tendency toward the adoption of the sloping or tapered engine hood so prominent a feature of foreign cars. Between the engine hood and the dash we now have a concave scuttle instead of one that is convexed in a great many cases, and this, with the general tendency toward the carrying of spare tires at the rear of the tonneau, has had a great influence in altering the silhouette of the car. With deeper scuttles has come the dash gasoline tank, which bids fair to supersede the tank hung at the rear. Here again is the silhouette changed.

It is interesting to note—and the conclusion can be drawn from an inspection of almost any of the new models—that American designers at last appear to be paying much deserved attention to the Prince Henry type of stream-line body. Slowly it is being driven home that vehicle efficiency can be increased by the simple expedient of carefully designing body curves so as to take advantage of the entering-wedge principle. Although designers have not carried the idea to its extreme [illegible], the tendency is nevertheless toward a reduction of wind resistance. Body designers would do well to take a leaf out of the aeroplane builders' book in this respect.

Another feature worthy of more than passing note is the unmistakable trend toward the adoption of domed mudguards. Two years ago not more than two or three American cars were fitted with them. Now, however, it is different. Not only do the domed mudguards fit the wheels better—of itself a laudable attempt to enhance appearance—but they act as a surer protection than do the flat ones, and for this reason they must be hailed as a material improvement.

With mention of the general widening of seats and doors, the latter being now for the most part of the full U shape, the clearing of running boards and the almost universal adoption of windshields that are built into place and no longer can be looked upon as accessories, bodies can be dismissed. It is pertinent to add, however, that left side control has materially increased in popularity, a fairly large number of makers who last year clung to right side control, having switched over in response to the insistent demand. One maker who retains right side control has solved the problem by hinging his steering wheel so that it may be folded down out of the way of passengers entering or leaving the front compartment.

With regard to mechanical construction, the influence of the Knight type engine, which appears to be holding its own in public esteem even if it has not made a remarkable gain during the past twelve months, is more than ever apparent in the efforts which have been made to silence poppet valve mechanisms. There is scarcely a maker who does not inclose valve parts by way of muffling such slight noises as cannot be eliminated by more careful fitting and the reduction of clearances to the minimum. The growing use of the so-called silent chain for camshaft and magneto drives is generally credited with reducing the noise of operation considerably.

There is a well defined tendency to reduce the weight of reciprocating parts by way of reducing vibration, and smaller bores with correspondingly higher piston speeds are coming into greater favor; but the stroke to bore ratio gives no indication of increasing.

The year has been marked by the attempts of several makers to equip their cars to use kerosene, and in at least one case results have been so gratifying that the maker feels justified in warranting results with the heavier fuel. At the same time those who cling to gasoline have in many cases made attempts to increase engine efficiency by dash carburetor adjustments, whereby either the supply of fuel or of air or both can be readily adjusted by the driver. Dashes in general carry more equipment than they have in the past. The attempt of a year or so ago to clear away everything off the dash, leaving nothing for the operator to watch, has come to nothing, and dashes now are cluttered up to a greater extent than ever before.

In the mechanical construction of the car, no startling changes have been made. The four-speed gearset holds its own, as does the bevel gear final drive. Contrary to the general belief of a year ago, the worm drive has not made the advance that was promised for it. Instead, makers seem to prefer the perfection of the bevel drive or the adoption of something else, the ingenious combination of bevel and spiral gear that has been placed on all the cars of one maker serving as an excellent case in point. Abroad there has been developed and placed in use by one maker a double herringbone driving gear. Nothing of the kind has as yet appeared in America.

In conclusion we would add that no review of progress would be complete without at least passing mention of the recent development of the miniature automobile which has come to be styled "cyclecar" for the want of a better name. That the present demand for these vehicles is largely an assumed one is the consensus of opinion of automobile engineers, and several of them even deny the permanency of the type, primarily because of its narrow tread and the difficulty of producing it at a price low enough to avoid skimping in construction.

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[illegible]

E[illegible] Moore [illegible] and K. L. Kithil, [illegible] vanadium ores, the [illegible] the development of methods for [illegible] raw material into finished products. [illegible] side of the investigation Dr. Moore was assisted by C. F. Whittemore.

As a result of [illegible] recently issued by the Bureau of Mines, it has been definitely shown that, although the Austrian government has conserved its own resources of uranium and radium by purchasing the Joachimsthal mines and by carefully supervising pitchblende production, the deposits of radium-bearing minerals in the United States are being rapidly depleted by wasteful exploitation, chiefly for the benefit of foreign markets.

Seemingly the country has been quite unaware of the extent to which uranium ores have been sent abroad. Investigation has developed the fact that during the year 1912 carnotite ores carrying 28.8 tons of uranium oxide were produced and that practically the entire amount was exported. The major part of this ore carried between 2 and 3 per cent U_3O_8, as it appears that no ore carrying less than 2 per cent can at present prices bear the cost of transportation. This means that 8.8 grammes of radium chloride, or an equivalent 11.43 grammes of radium bromide, will be obtained from the ore shipped from this country in 1912. Only one American company has been preparing radium salts of a high degree of radioactivity, and its product has only recently been offered for sale. The American ores exported were purchased for their radium content. It is improbable that all of the ores exported are now represented by finished product, but the 1912 production of radium from American ores can not have been much less than the quantity mentioned, for uranium was being shipped abroad in almost equal quantities in 1911, and is still being sold for future manufacture. It can probably be definitely stated that in 1912 there was obtained from American ores nearly two and one half times as much radium as from all other sources combined.

In the mining of uranium ore, for every ton marketed there are at present some five tons of low-grade material thrown on the dump and much more left in the mine awaiting only a feasible concentration process for commercial exploitation. Mr. Kithil has shown that elutriation can be applied to both uranium and vanadium ores and that a large proportion of the valuable material now going to waste can be readily obtained in marketable condition. If water is not available, air separators may be used, or other devices for dry separation. The uranium deposits of Colorado and Utah are being rapidly depleted for foreign exploitation, and it would seem to be almost a patriotic duty to develop an industry that will retain our radium.

Although no one can predict with certainty the value of radium or its possible application to science or medicine, the subject is certainly well worthy of investigation by our highest scientific authorities, and under proper technical control, it opens to American industry a profitable field for exploitation.

Although at $90 per milligramme for radium chloride the total value of the radium shipped in 1912 amounts only to $792,000 and the mining and separation of the ore can accordingly be considered only as one of our smaller industries, the fact should be noted that of this amount approximately $716,000 went into foreign hands and opened to foreign medicine and science opportunities in this most promising field that have been denied to our own people, except by repurchasing the manufactured radium compounds at an almost prohibitive price.

France, Austria, England, and Germany have their radium institutes fostered by their governments or by philanthropic foundations. Up to the present time, although the United States has been furnishing a large part of the material for these foreign institutions, comparatively little has been done in the hospitals and laboratories of this country.

A Meteorological Office in Edinburgh.—The British meteorological service, in cooperation with the Scottish Meteorological Society, is planning to establish an office in Edinburgh, [illegible] Office, London, [illegible] information will be [illegible] authorities and the public.

[illegible]

[illegible] was [illegible] the dis- [illegible] with- [illegible] that [illegible] by a [illegible] Navis [illegible] it is safe [illegible] will be more [illegible]

[illegible] is advocated by Dr. Charles A. R. Campbell, who claims to have exterminated countless millions of the malaria-carrying pests by means of a "bat roost" erected alongside a large body of foul, stagnant water near San Antonio, Texas. The roost is a tall wooden structure, not unlike the [illegible] places of [illegible] during the day. It is provided with a tall [illegible] free ingress but [illegible] light. Dr. Campbell finds that mosquitoes are by far the commonest food of bats. Since the roost was erected, in 1911, it is claimed that both mosquitoes and malaria have become scarce in the neighborhood.

Plans for the Proposed College of Tropical Agriculture in Ceylon, mention of which has already been made in these columns, have recently made rapid progress. The college is to occupy 40 acres on the left bank of the Mahaweli River, opposite the Royal Botanic Gardens at Peradeniya, at an elevation of 1,600 feet above sea-level. The main buildings, which will cost $200,000, are to be arranged similarly to those of the Cornell College of Agriculture at Ithaca, N. Y. The lectures will provide for two groups of students; men with degrees in agriculture who wish to specialize in tropical agriculture may take a one-year course, while courses of two years or more will be given to less advanced students.

Sleeping Sickness Investigations.—By way of a postscript to the article on sleeping sickness in the SCIENTIFIC AMERICAN SUPPLEMENT of August 15th, it may be stated that Sir David Bruce, during a recent brief visit to England before resuming his work in Africa, declared that the sleeping sickness in Nyasaland is not the same as that of Uganda or of the West Coast, although it belongs to the same category. It is more rapid and equally fatal, no cases of recovery having been recorded. According to the London Times, the Colonial Secretary has appointed a committee to investigate the whole subject of the spread of trypanosome infection among man and stock by tsetse flies in Africa. It is proposed to try an experiment of game destruction in a localised area, and to consider whether it is advisable to attempt the general extermination of wild animals with a view to checking these appalling diseases.

The International Institute of Agriculture now numbers 53 countries and colonies among its adherents, the latest additions to the list being Paraguay, Guatemala, the Dutch East Indies, the Union of South Africa, Tripolitania, and Cyrenaica. The fourth session of the general assembly of the Institute was held in Rome, May 6th to 12th, under the presidency of Count Francisco Guicciardini. The United States was represented by five delegates. Probably the most important subject of debate was that concerning the promulgation of an international agreement in regard to the control of plant diseases. At present many countries, including the United States, enforce plant quarantines or otherwise contribute to the common task of checking the spread of plant diseases, but many others do not. Although the assembly passed resolutions in favor of the maintenance of government phytopathological services throughout the world, an international service seems still remote. It is hoped that the French government will soon convoke an international meeting of specialists to consider this question. To meet the growing expenses of the Institute, it was decided to increase the subscriptions of the adhering countries; that of the United States will hereafter be [illegible] per annum. The recent publication by the Institute of the [illegible] Year-[illegible] is said to have greatly [illegible] international data, [illegible] the work of [illegible] for its [illegible] connected with the [illegible] languages [illegible] the project is now under consideration of compiling a polyglot vocabulary of the [illegible] terms employed in agriculture. [illegible] affirming the [illegible] of protecting [illegible] its further [illegible] were the [illegible] concerning [illegible] fertilizers.

Automobiles

[illegible] died recently in Paris. He was considered one of those who had done most to advance France to a leading place among the nations in the motor car industry. [illegible] claim to fame, however, is his services in 1908 to Wilbur Wright. Wright found a friend in M. Bollée who placed his services at his disposal and brought about the demonstrations at Le Mans which convinced the French people that heavier-than-air flying machines were an actual possibility. From then on, Wright's success was assured in Europe.

Now Comes the Home Gasoline Still.—On account of the constantly increasing and almost prohibitive cost of gasoline as an automobile fuel, competition has become keen in the production of motors, carbureters, fuel savers and even low grade fuels. However, an English company has designed a small still by means of which an automobile owner may convert four gallons of crude oil into three and a half gallons of fuel in two hours. The oil is placed in the lower part of the still and heated by means of a burner underneath, this burner being operated on gas or oil. The vapor arising from the heated oil is condensed in cooling coils surrounded by cold water, and is drawn off at the side into any suitable tank or vessel.

An Unusual Type of Car Heater.—To utilize some of the heat of the waste products has been the object of quite a number of persons who have sought to increase the comforts of winter motoring; but not all of them have been successful. A new type of heater that but recently has made its appearance has a number of commendable features, first and formost of which is that it may be easily attached by almost anyone who is handy with tools in a short space of time. In its simplest aspect the heater is nothing more than a miniature radiator such as commonly is used for hot air, steam and hot water heating. Part of the exhaust gas is led from the exhaust pipe through the radiator, whence it escapes through a relief vent to the outer air. It is in the manner of admitting the heated exhaust products to the radiator, however, that much of the novelty exists. Instead of a plain valve in the exhaust pipe there is a rotor, operated by the pressure of the exhaust gas, which in turn opens a small disk valve that admits part of the products of combustion to the radiator; thus only a small part of the gases pass into the radiator, the exact amount being governed by a small lever which in turn is connected to the disk valve so that the opening may be varied. As the heating surface is large and the tubing is fairly light only a comparatively short time need elapse before the heat is felt by the occupant of the car. To attach the device it is merely necessary to section out a small piece of the exhaust pipe and substitute for it the combined rotor and valve that go with the heater. In the construction, two heaters are used, one in the front and one in the rear of the car, though only one need be used and it can be placed wherever the fancy of the owner dictates.

A Semi-solid Pneumatic Tire.—A new tire has made its appearance, which is a sort of combination of solid and pneumatic. It is not unlike the ordinary tire for which it can be substituted without alteration in existing standard tire-rims. Its principal point of difference lies in its enormously thickened tread and in the unusual manner in which the tread is formed. The tread itself is four or five times as thick as the normal tread and formed in it there are a number of very deep indentations alternating on either side and overlapping slightly at the center of the tread. Between these indentations, at the sides there are other scooped out places, the purpose of which is to assist in the radiation of natural heat. By means of the deep indentations it is pointed out that the principal drawback to the solid tire, barring its lack of resiliency, of course, is eliminated. This drawback it may be explained is due to the fact that the weight of the car and its progression force a ridge, or wave, of rubber around the tire just in front of the point of contact between the tire and the road, the net result being that the tread soon loosens itself from the base and comes away. The indentations, it is claimed, do away with the travel of this wave by permitting distortion to take place and allowing for the return of the rubber to its natural form. Incidentally, their edges provide a means for the tire to bite its way through mud or water and [illegible] an acquaintance with the roadway itself. Consequently the tire is practically nonskidding. The thickness of the tread obviously accounts for the fact that the tire is more than ordinarily resistant to punctures and blow-outs and so confident are the makers that the tire will not only stand up in service but will stand up an unusually long time to boot that they unreservedly guarantee it for 5,000 miles, 1,500 more than the manufacturer of ordinary tires. Despite the heavier tread of the tire, which is used with the ordinary inner tube, its weight averages only about 10 per cent more than the weight of the ordinary tire.

Centrifugal Force on Automobile Tires

By C. E. Palmer

AT first glance it would seem that each and every element going to make up the running gear of the modern automobile is balanced to such a nicety that any speed attainable under normal conditions would hardly be sufficient to necessitate serious consideration being given to any small, unbalanced weight. However, it has been demonstrated that even such a small weight as the tire valve is subjected to sufficient centrifugal force at high speeds, especially in racing cars, to warrant the placing of an equal weight on the opposite side of the wheel to overcome the energy developed by the rapid motion of the unbalanced valve.

The valves, including their caps, vary in weight for the different sized cars on which they are used, from 3½ to 8½ ounces, and these weights seem insignificant when compared with the weight of a wheel and rim. But when the wheel is revolved at several hundred revolutions per minute a considerable centrifugal force is exerted, acting at any point in its travel radially away from the center of the wheel. It is intended to show here the tremendous forces that are developed at different speeds if the valves are not counterbalanced by weights on the opposite sides of the wheels.

The velocity in feet per second of any particle of matter moving in a circular path with a constant radius, is represented by the product of the circumference and the number of revolutions per second. Now the centrifugal force of the same particle is the product of the weight and the square of the velocity, divided by the product of the radius and the force of gravity, which is 32.16 feet per second. Then substituting the value of V^2 in this second formula, we derive the equation, $C = 0.00034\ W\ R\ N^2$ pounds, where W is the weight of the body, R the radius of action, and N the revolutions per minute.

For the purpose of demonstrating by means of this formula, the necessity of balancing the wheels on high speed cars, values will be assumed to correspond as nearly as possible to actual practice. Let the distance from the center of the wheel to the center of gravity of the valve, be 15 inches; the weight of the valve and cap, 7½ ounces or 0.468 pounds; and the diameter of the tire, 36 inches. Cars which will not attain a speed of 60 miles per hour are unusual, and it is an every day occurrence for racers to maintain a speed of 75 or 80 miles per hour throughout a long contest or trial run. As a speed that is not at all unusual, let us assume 70 miles per hour for the first example. This is equivalent to 6,160 feet per minute, and in traveling at this speed a wheel with a 36-inch tire will make 654 revolutions per minute. Substituting these values in the above equation we get:

$$C = 0.00034 \times 0.468 \times 1.25 \times 654 \times 654 = 85.1 \text{ lbs.}$$

In other words a 7½-ounce valve on a 36-inch wheel traveling at 70 miles per hour will exert a lifting force of over 85 pounds when the valve reaches the top of the wheel. In case both valves of either pair of wheels are in the same relative position with regard to the axle, they will exert a combined lifting force of 170.2 pounds, and if they are opposite each other there will be a seesawing force acting on the car. Considering that there are four of these valves it is easily seen that they will exert forces in various and constantly changing directions as the wheels shift their relative positions in rounding turns in the road.

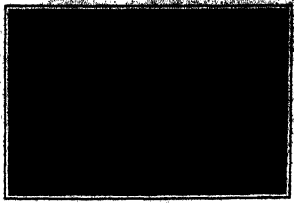
Since the centrifugal force varies as the square of the speed it requires only a slight increase in the speed to make a large increase in the force exerted. For instance, if the car travels at 75 miles per hour the force is increased to 97.5 pounds, and at 80 miles, which is frequently attained, the force on each valve will be 111.3 pounds, while at only 40 miles the force is 28 pounds. In a car going at the fastest rate of speed yet attained by man, 142 miles per hour, the force exerted by the valve is nearly 400 pounds.

Considering these almost neglected forces it is easily seen that some cognizance of them should be taken the same as is done is designing balanced wheels of stationary machinery. That racing drivers are coming to realize what these neglected forces might mean in case of an accident and loss of control of the car, is shown by the fact that a famous English driver has equipped each of his tires with two valves instead of one, the valves being placed on opposite sides of the tires in order to provide a perfect balance. It is said that the car will run at 80 miles per hour and hold the road remarkably well, where before it skidded badly at high speeds and was very difficult to control. Many American drivers also balance their valves by placing metal weights on the rim or felloes of the wheels opposite the valves.

Elk in Utah.—Elk have been found in the Uinta national forest, Utah, for the first time in many years. Since they are not from shipments from the Jackson Hole country to neighboring forests, the State and Federal officials are gratified at this apparent increase in big game as the result of protection.

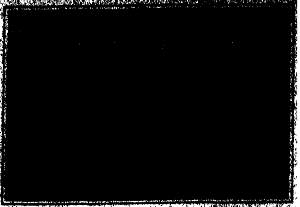
An interesting example of the "boat type" body.

The peculiar feature of the design lies in its ram-like forward lines and its torpedo stern; it is styled a skiff-torpedo and the body, though metal, is grained to represent wood. Lightness of construction evidently was sought, for running boards are missing and the mudguards are small.



Modified type of two-passenger coupé model.

When closed, this body has much the appearance of a "conning tower." It is a good example of the European practice of sloping the engine hood sharply to blend with the lines of the deep scuttle. Owing to the lowness of the chassis, the body appears somewhat squat when the back is folded up.

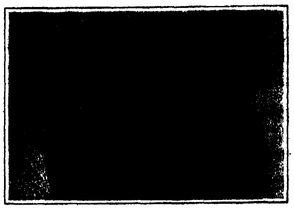


A clever solution of the seating problem.

In this body, the designer has placed the [illegible] seats en echelon by way of giving all three occupants plenty of elbow room. The design, incidentally, provides for sociability among the passengers; conversation is facilitated, for no one is required to lean over any one else.

Ingenious storage spaces that satisfy a real demand.

To provide for the safe carrying of goggles, gloves and the hundred and one other motoring necessities is not always easy, though the designer of this body has not found it particularly difficult. In the average American car, storage space of the kind is unknown.

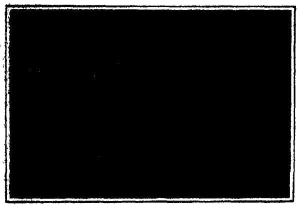


Is closer resemblance to a real boat possible?

The fidelity with which the boat builder's art has been imitated in this body is truly astonishing; the "hull" is properly built up of a number of "skins;" decks are laid in true nautical fashion and even the cockpit has a coaming. Note the protected fuel tank.

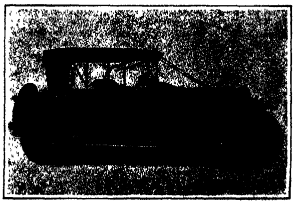
Dodging the conventional in front elevations.

The resemblance to an aeroplane with its widespread wings is unmistakable. The miniature "side" lamps, set into the dash, are in marked contrast to the powerful head lamps. The windshield, unbound at the top, reflects a well-defined tendency in design. The body is styled a skiff-torpedo.



Side view of lately developed runabout model.

Compactness is the predominating feature of this vehicle which somewhat resembles a great black beetle, what with its sloping front and rear and its low-hung chassis. The provision of ventilators on the rear luggage compartment is unusual.



American three-passenger car that is different.

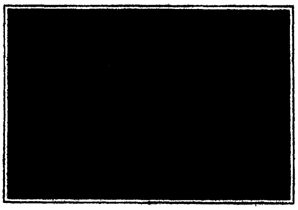
The third seat at the rear closes up out of sight and when closed is waterproof; besides it there are commodious lockers. The position of the tool box is worthy of note, for though fairly large, it does not obstruct the running board

Clever combination of sedan and limousine.

When the top is folded back, as shown, the body is to all intents and purposes an open touring body; but when it is raised the occupants may be as snug as the proverbial bug. What a contrast between the curving fender line and the severity of American practice!

Another of the curious foreign "boat" bodies.

The exaggerated flare to the top-sides, the tiny after cockpit and the peculiar stern all proclaim the marine origin of the type. Mudguards are reduced to the minimum, it will be noted, and there are no side entrances to the single rear seat; running lamps are mounted atop the head lamps.



How foreign designers reduce wind resistance.

Type of racing body in which the stream-line principle is well exemplified, the theory being that the pressure at the rear nearly neutralizes the head resistance. The extreme to which the idea is carried is indicated by the rudder-like projections on the rear frame members.

Another view showing lines of the "terra marine" body

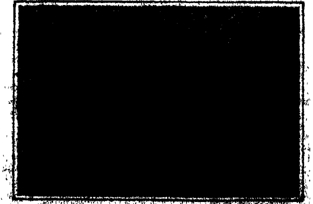
From the side, the resemblance to a boat is even more pronounced; the lines are those of the typical, fast runabout launch. The illusion is made complete by holding a card so as to obscure the engine hood. This body caused a genuine sensation at the recent French salon.

A representative type of fast foreign runabout.

Disked wheels, practically unknown in America, serve to reduce wind resistance and to promote cleanliness; they are fairly common abroad where little attention is paid to convention in the matter of appearance Note the "turtle-back" rear effect and the lowness of the chassis.

The exaggerated coupé type of town vehicle.

The apparent great length of the chassis is accounted for by the fact that more than half the space is taken up by engine and driver. The abrupt, unfinished appearance of the inclosed part offsets the elaborate attempt at line blending at the front.



Brand new arrangement of seats and storage space.

It will be noted that the forward seats are [illegible] for the [illegible] purpose of providing both [illegible] of room, and half the tonneau is [illegible]. The body is a utilitarian one, though the [illegible] is somewhat limited.

NEW IDEAS IN CAR BODIES DEVELOPED CHIEFLY ABROAD

The Adaptability of the Motor Truck

Installations That Fail Because the Trucks Are Not Worked to Their Full Capacity

By W. A. McDermid

As a piece of labor-saving machinery, with a very wide range of designs and sizes, it is obvious that the motor truck should be selected with a view to its exact fitness for the character of the work. This is, in fact, so obvious that too much emphasis has been placed upon it, and it has been made the prime consideration in the operation of motor vehicles, with the result that through the neglect of other and more important factors, the truck has had to bear the blame for failures to produce the economies of operation of which it is really capable.

The evidence which demonstrates the advantages of motor truck transportation is so overwhelming that it is difficult to understand why there should be in many cases a serious question as to the real value of the truck. Yet far-seeing truck makers, their salesmen, and thoughtful business men who are considering this investment are frankly facing this situation and seeking to determine the reasons back of this condition in the motor truck industry.

It is apparent to them that there are hundreds of very successful motor installations where a large economy in dollars and cents is clearly traceable. There are many others in which a premium—an additional cost—is gladly being paid because of certain superior facilities or services which the motor truck affords, and which are considered worth the price and therefore a profitable investment. And there is a third class, in which the cost of operation has been so prohibitively high, as to render the purchase of trucks an apparently mistaken investment.

Part of this last situation has been due, no doubt, to the over-enthusiasm of the truck salesman, who, in perhaps an excusable zeal for his product, has led the prospect to expect the impossible, or has failed to analyze the customer's needs, or, having analyzed them, has not been sufficiently frank to admit the inadequacy of his particular make for the purpose.

While the manufacturers themselves realize this tendency and for the most part combat it vigorously, this is not, however, by any means the root of the trouble. There are instances beyond number in which the customer has been clearly and honestly forewarned of what he must do to get efficient results, only to utterly ignore or disbelieve the warnings. The problem lies deeper than this, quite apart from the fact that even if the truck does not live up to the most sanguine statements of the salesman, it should still (under normal conditions) give a more than satisfactory efficiency.

Nor is it primarily due to the fact that the wrong truck has been purchased for a given class of service. Certainly there have been a very great number of mistakes of that kind—mistakes which every man, in whatever capacity, who has the interests of the industry at heart, whether as user or maker, deplores and earnestly seeks to prevent.

Regrettable as such purchases are, it is nevertheless true that even where the truck is perfectly adapted, in style, size and equipment, to the required class of work, there is, in a large number of instances, a heavy loss in economy. It is in seeking to arrive at the underlying cause for this loss that we reach a basic solution of many of the problems of motor transportation.

It is the natural and logical reasoning of the salesman and the purchaser that if the truck itself is well designed and made (and in the present state of the industry there is an ample choice of such trucks); if it is the suitable type for the work in hand, and if it is placed in the hands of a competent man, it should prove to be an unqualified success. This reasoning, however, is not justified by experience.

An analysis, based on accurate time studies and investigations of operating conditions, of more than two hundred average motor delivery services, in twenty-eight cities, and in forty-two lines of business, each with unique problems, reveals as a generalization that the average motor truck is from *twenty-five to fifty or even sixty per cent below normal efficiency.*

A very small percentage of this is due to defects in the machines themselves. When repair bills or maintenance expenses are unduly high, they are not traceable, except in a few cases, to bad design or construction, but to careless use.

And the cases of error in selection of the type of truck, while considerably greater in number, still do not represent the major part of the problem. In fact, the most common error of this class, the use of too heavy a type for parcel service on short runs, is due primarily to a scarcity of suitable parcel-car types. In the heavier trucks it is apparent that because of the wide variations in weights and sizes of load units, some inconsistencies are inevitable, and the truck makers have provided for this by a reasonable factor of safety in construction.

The conclusion is, then, that the truck is not properly used by the purchaser in a large number of instances; a fact which has been blamed to the driver, the repair man, the garage superintendent—to every one, in fact, except the real source of responsibility—the management.

The adaptability of the motor truck to its work, barring certain minor considerations, resolves itself into the question as to the amount of intelligent effort the management is willing to expend on it.

There is no other way to account for such a comparison as Figs. 1 and 2. These represent total hours in service and the relation of working hours to idle hours, *of a motor truck selected at random from the fleets of two companies situated near each other in a large city, with the same kind of tonnage, and the same make of truck.* The comparison is as fair as could be made. Both drivers are above the average in ability and intelligence. Truck 1 is not profitable. Truck 2 is paying good dividends, in service fewer hours, and handling greater tonnage.

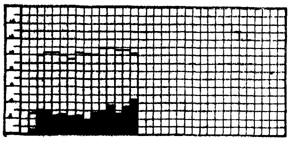


Fig. 1.—Relation of working to idle hours of a motor truck.

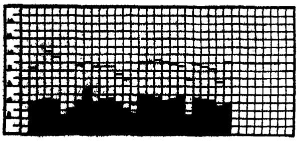


Fig. 2.—Diagram of a profitable truck engaged in the same work as Fig. 1.

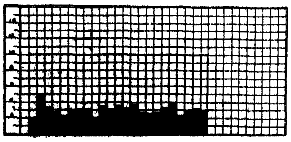


Fig. 3.—A thirty-day analysis of an unprofitable truck.

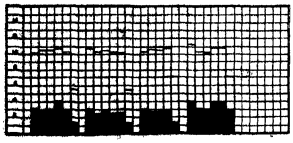


Fig. 4.—Same truck as in Fig. 3 after the management had investigated the delivery service.

Figs. 3 and 4 are the graphic presentation of a thirty-day analysis of similarly parallel conditions in another industry in a smaller city, before the attention of the management was directed to the delivery service in anything more than the usual perfunctory way. After analyzing tonnage, trips, necessary loading and unloading time, etc., it was apparent that increases in efficiency to average 28 per cent in productive working hours were possible, and within ninety days practically all of this increase was effected.

These will serve as illustrations of the principle underlying the economical administration of motor trucks, namely, the importance of the productive working hour. The generalization that a truck must be kept busy is currently accepted and preached broadcast, but there is an appalling amount of misinformation as to how much work the truck in question is actually performing.

Men who are conscientious in the belief that their trucks are rushed to capacity, and who are contemplating the purchase of additional vehicles, are utterly amazed to be confronted by indisputable evidence that their trucks stand idle as high as 60 or 70 per cent of the working day. In fact, those percentages might almost serve as an average.

Many of the secondary ills of the motor truck are traceable to that condition. Bad planning on the part of the management (or lack of accurate information) forces the shipping clerk to overload on each trip to get out the goods—a necessity which extra trips, in a well planned day, would eliminate. The driver is compelled to overspeed to meet the pressure. The result is high repair bills and bad service. The most common and serious mistake is in attempting to cure these symptoms instead of getting down to first causes and considering the motor truck as it should be considered—a unit of productive machinery.

Hundreds of owners are spending large amounts of money and time in keeping elaborate records of costs, and investigating cases of trouble, without recognizing that the same principles of planning and management that apply to the machines in their factories apply in *the same degree to their motor trucks.*

When a truck has been considered with respect to the weight and size of load units for delivery, the territory to be covered, and whether the load is for distribution or delivery at destination as a unit, and has been selected to conform to the conditions, the owner is still far from receiving satisfactory service unless he applies to it the basic theory of manufacturing efficiency—*the largest number of productive minutes of time per unit of machinery.*

Failure to apply this standard is accountable for the fact that there are relatively few fleets that do not contain more units than are necessary for the work in hand.

To take a concrete illustration, a large wholesale grocery company, operating four large trucks (three different makes) found their cost far above that of horse delivery. A time study showed that these trucks averaged barely three productive working hours a day, and the fault was shown to lie in shipping room congestion. The trucks were in no way at fault—they were giving splendid service. But to restore the delivery department to its old costs, or decrease them, it was necessary to improve shipping facilities or go back to horse trucking. By electing the former method, this company is getting the benefits of truck service at a normal cost.

By way of contrast is the concern which operates four trucks which were shown to average but two hours and twenty-five minutes a day of *running time*, yet who ignored the point and purchased two more trucks, when three trucks in all would amply care for the work under proper supervision.

Cases like these illustrations are not the exception. On the contrary, they are so frequent as to be a serious menace to the success of the motor truck. They are changing the motor truck from a powerful servant of society, cheap and efficient, to a costly and wasteful addition to the machinery of distribution.

And the process will continue until the owner learns to discard the standards of horse delivery and apply the principles of engineering to his equipment, and until the maker recognizes that it is not sufficient that he sell trucks to those who will buy, but that he must sell them where they *are really needed, and only then.*

As standards for the successful operation of motor trucks, it is logical to adopt the same principles of production engineering that apply to the lathe, the automatic screw machine, or any other piece of productive machinery. These may be summarized as follows:

1. The machine must be of exactly the right type for the particular class of work it is turning out.
2. No unit must be added, until each preceding unit is working to its capacity.
3. The raw materials of manufacture must be accessible with least possible expenditure of effort and time.
4. The finished product must be promptly removed.
5. The operator must be skilled in the use of the machine.
6. The machine must be subject to the frequent inspection of a competent mechanic. "A bolt in time saves breakdowns."

(*Concluded on page 36.*)

Good Lubrication—The Motor Conserver

Motor Oil in a New Light

By Harry Tipper

One thing which distinguishes the efforts of men in any direction from the accomplishments of nature, is the small amount of useful work secured by man in proportion to the amount of energy which goes to waste compared with the absence of waste in nature and the complete conversion of all energy into useful work of some kind. The actual amount of power turned into useful work in an automobile compared with the amount of energy represented in the fuel, is only a fraction of the theoretical possibility; neither is the length of life of the parts of an automobile anything but a fraction of what it should be.

Friction—that is, the resistance to movement of one part in contact with another—is one of the largest contributing causes to loss of power and deterioration, and as a consequence of this the effect of lubrication upon the wear and tear, the ability of the motor to withstand strain, and the power delivered, is of the utmost importance and can hardly be over-estimated. Even the spring which supports the body will remain in service infinitely longer if a little care is bestowed on the lubrication between the leaves, so that the movement of one leaf upon the other will be unrestricted and without undue strain upon the metal.

The efficiency of lubrication in any motor driven vehicle depends only to a certain extent upon the character of the oil, other factors exercising a considerable influence upon the results which are obtained. The design of the motor, the design of the lubricating system, the care bestowed upon the running of this system, the character of the oil itself, the care bestowed upon it in refining and distributing, all exercise an influence upon the lubrication and its value as a conservation measure. In this article, written by a well known expert, the importance of good lubrication in automobile operation is considered from a new angle.—Editor.

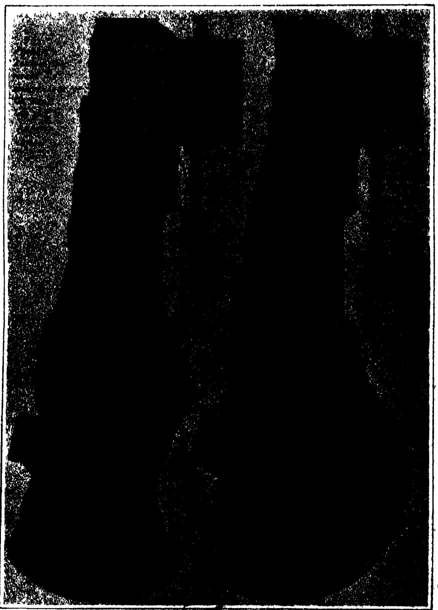
CONSERVATION measures are always the least understood and the last to be investigated. It is, therefore, to be expected that comparatively little study should have been given to the question of lubrication except in the oil business, and only a partial study has been given to it even in that business. Primarily because the study of lubrication in the oil business has been from the standpoint of determining the best way to market certain oils and not always from the standpoint of arriving at the most efficient means of lubricating. This is, of course, to be expected. It does not, however, excuse the engineer who is interested in motor lubrication from the criticism which the neglect of this important subject rightly subjects him to. Little, if any, attention has been paid by the automobile engineer (until the last two years) to the factors which enter into and affect the efficiency of lubrication, and where these factors have been taken into account by the oil manufacturer they have been considered only as exercising a controlling influence upon the character of the oil required. Whereas, it is entirely probable that the character of the oil adapted to the work is not materially affected by the changes in the design of the motor, the lubricating system or other conditions, but rather these conditions have an effect upon the final efficiency of any lubricating oil which is used.

Moreover, where attempts have been made to scientifically consider the character of the oil necessary for efficient lubrication, the conclusions reached and the deductions made from such consideration generally show either a partial knowledge of the conditions in the oil business and the requirements of the motor, or a neglect of some of the factors entering into the case. It is not many years ago that gasoline of high gravity was considered necessary to secure any power, although now it is generally understood that a lower gravity gasoline means greater power and more mileage per gallon and that gravity may change in the gasoline produced from different crudes without affecting the starting value or volatility of the product. These later developments have shown definitely that the characteristics by which the general public (and even the trained engineer) have been used to measure gasoline have little, if any, bearing upon its value as a motor fuel.

Physical Tests Are Not Always Final.

It is now understood by some oil experts (who have conducted their researches very carefully into the conditions in a number of oil fields and conditions in the motor business) that some of the physical characteristics of lubricating oil which are generally quoted as being synonymous with good lubrication, have little to do with the mechanical efficiency of the lubricating oil under working conditions. In this respect oil values are much like creeds and political traditions, the old habits of expression remain long after the deficiencies are known.

Many years ago, when the crude oil all came from the same part of the country and possessed practically the same characteristics, chemical composition, etc., it was a comparatively easy matter to determine whether a uniform oil of uniform value was being secured. Consequently, the crude oil from which the lubricants were taken at that time passed into the standard, and the general physical characteristics were used as expressing the standard of requirement. Later discoveries in oil fields have shown that, like all natural products, oil varies in its chemical and physical characteristics, according to the deposit, and these varying deposits cannot be measured solely by the values established by the characteristics of one field. On account, therefore, of the absence of any valuable standard of comparison in the oil business, and the conflicting opinions which have developed in the study of motor lubrication, the only way to properly consider this subject is to ask what the requirements are and see what qualities are necessary to fulfill them.



If the seal between the piston rings and cylinder walls is good, the mixture will be compressed to a high degree. In order to maintain good compression in the cylinder, an oil must evidently be used which will adhere to the cylinder walls, filling the space between the piston rings and the cylinder walls. If there is a slight leakage on each compression stroke, gasoline may seep into the crank case, making the oil absolutely unfit for further use

The effect of good and bad lubrication in an automobile engine.

How Lubrication Affects Compression.

Inasmuch as most of the obvious trouble in connection with the lubrication of motor driven vehicles comes from the motor cylinders, this point should be considered first. The performance of the motor of any gasoline driven vehicle depends upon the maintenance of the compression, and the efficiency of the motor depends to a considerable degree upon keeping this at maximum point.

It is obvious, upon consideration, that it is practically impossible to fit the moving piston into the cylinder so closely as to secure a high compression without increasing the resistance or friction to such a point that it will absorb a considerable amount of power in turning over the motor without doing any useful work. During the suction or admission stroke, the admission valve is so arranged that it will not admit air into the cylinder as fast as the piston displaces it. This results in creating a partial vacuum which carries the gasoline and air mixture through the carbureter. This partial vacuum will at the same time carry the lubricating oil up past the piston rings into the compression chamber unless this oil is sufficiently tenacious to adhere to the cylinder walls.

The amount of lubricating oil which passes the rings and gets into the explosion chamber during the stroke is greater or less according to the fit of the piston rings in the cylinder and to the character of the lubricating oil. These same conditions—that is, the fit of the piston rings and the character of the lubricating oil—affect the compression, which can be secured and maintained during the next stroke. The compression which occurs during the next stroke is caused by the movement of the piston upward in the cylinder and this compression depends largely upon the close fit between the piston rings and the cylinder walls; upon the number of rings; and upon the way in which the oil will form a seal between the cylinder walls and the piston rings. When the cylinder is closed, the only loss of compression comes through the fit of the valves, poor mechanical fit of the piston rings or poor and faulty lubrication.

The lubricating oil may be indirectly the cause of poor mechanical fit of the valves and piston or rings on account of hard carbon being deposited thereon. Poor lubrication, even with a good oil, will result in a loss of compression without regard to the perfect mechanical fit of the piston rings. With good lubrication and an oil of the right character, the compression can be maintained even with worn-out rings and a loose piston.

On the next stroke, the explosion of the mixture and the consequent expansion of the gases therefrom produces the power to drive the motor. Provided the carbureter is properly adjusted so that the mixture is in the right proportion for effective work, the amount of power developed from the explosion is largely dependent upon the compression secured during the second stroke; the greater the compression secured during that stroke the greater will be the initial pressure at the time of explosion, and consequently the greater the force of explosion.

If the seal between the piston rings and cylinder walls is maintained perfectly, the mixture during the second stroke will be compressed to a high degree. At the same time, during the explosion or power stroke none of the force (which should be expended in driving the piston down) will be lost through leakage past the piston rings. Of the power developed by the motor, the percentage which can be used to drive the motor forward, is dependent not only upon the degree of compression, but also upon the way the compression is secured. In other words, in order to turn the power developed by the explosion and the expansion of the gas into useful work, it is

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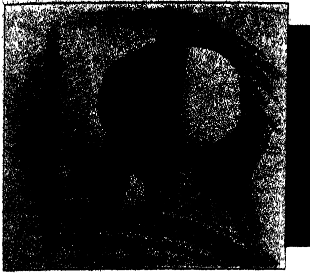
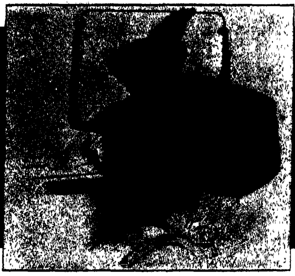


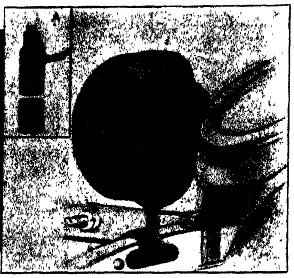
Lamp that illuminates roads without blinding others.

It has been one of the problems of those who design automobile headlamps to provide for proper illumination without blinding those who approach the lamps. In this design the solution has been attempted by showing the brightest part of the light against a light background instead of against the usual dark one. The front domes are ground glass with a small central clear portion.



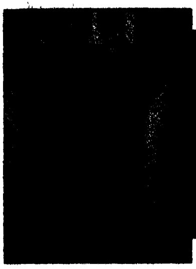
An adjustable windshield for tonneau passengers.

Few automobiles, if any, are sold without a windshield for the driver's protection, yet none are provided with a similar device for the protection of those who ride in the tonneau. This shield has been designed for the purpose. It is light and easily fitted to any body and can be adjusted to occupy a variety of positions. When not in use it is removed, taken apart and packed into a small case.



Emergency burner to make electric lamps burn gas.

We have had devices which transform gas and oil lamps into electric ones and now comes the device which makes an electric lamp into a gas lamp. It is for emergency use, of course, and manifestly cannot be used in the ordinary type of parabolic reflector lamp. The pillar is made to fit the usual electric light socket and can be quickly substituted for an electric light.

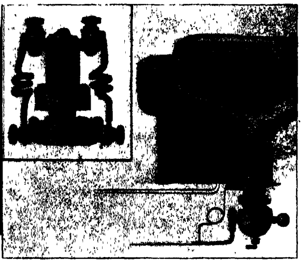


Heater built like a miner's lamp.

It is not a stove, however. Warm air is discharged at the top, but the sides do not get hot. It burns gas and is so arranged that hot air is kept in circulation, though the vent is outside the building. The makers say it cannot cause explosions.

Top that can be raised or lowered by one person without assistance.

The job of raising and lowering automobile tops always has been a difficult one. Usually it requires the undivided attention of at least two persons. With this design, however, one person can not only raise or lower the top without help, but, it is claimed, can do either with two fingers in about ten seconds. It is worthy of note that a great many automobile makers are equipping their cars with tops of this kind for the coming season, the movement, in fact being one of the revelations of the new models. The new top is supported only at the rear.

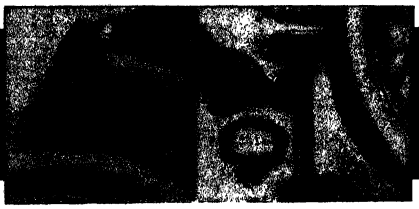


Electric device that helps the engine start itself.

We all know how hard it is to start a cold motor on a cold morning; not even the electric engine starter finds it an altogether easy job. So this device has been developed to assist in starting the engine. It is an electric heater operated from a storage battery. Pressure on a button permits a small quantity of fuel to pass over a heating coil which vaporizes it and fills the manifold with hot "mixture."

Providing automatic spring lubrication.

It is gradually coming to be realised that the leaves of springs require continuous lubrication to avoid squeaks and hard riding. The maker of this spring has overcome the difficulty by forming small grease receptacles near the end of each leaf. They are filled with hard graphite grease every six months, and the movement of the leaves one on the other serves to distribute the grease and provide proper lubrication.

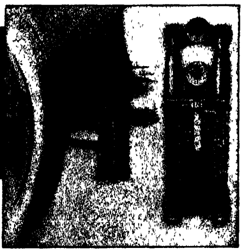


Signal appeals to two senses at once.

It is said that even the deaf take note of this combined bell and signal lamp! The lamp is in series with the bell, and when a button is pressed current from a battery rings the bell and flashes a red or green signal to draw the attention of pedestrians. Obviously it serves its most useful purpose at night. To satisfy the nautical mind, two signals can be used, red for left and green for right, with separate controls.

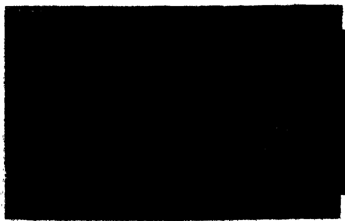
Jacking up the car by foot power.

Nearly every one knows how hard it is to operate a jack by hand under a rear gasoline tank, for instance; the foot is much handier for the purpose, so to speak. This is a stirrup which fits onto the handle of any jack so that the operator can insert his toe into it and hoist the car with his powerful leg muscles—and keep his clothes clean. For really heavy vehicles, strong biceps are needed when the jack is hand-operated.



To smooth out little bumps in the road.

The light springs preserve the chassis from the little jolts not absorbed by the regular vehicle springs, and at the same time act to reduce their natural period of oscillation. The large spring chamber is filled with oil which lubricates the parts and also prevents too rapid motion, thus giving a shock absorbing effect. The device takes the place of the common variety of spring shackle.

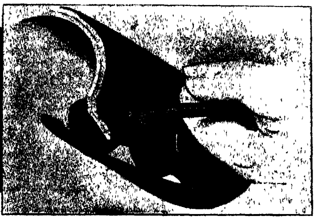


Novel type of "trouble" lamp that stays where it is put.

Magnetism is what makes it "stay put," which means, of course, that it must be "put" on either iron or steel. As the powerful magnet that holds the lamp is in multiple with the four-candle-power bulb, the outfit does not take much current; four dry cells are sufficient. Though designed primarily for the motorist it is a handy thing to keep about the shop. Needless to add, it will stick in any position, upside down or otherwise, and as the magnet exerts a pull of thirteen pounds it is not easily shaken loose.

New idea in mechanical horn construction.

The old-fashioned bulb horn does not emit a note sufficiently abrupt and compelling; its tone is too mild to be heard above the roar of traffic. This horn is one of the simplest that has been devised to take its place. Twirling the handle sets in motion a series of gears, thus causing a steel wheel to rub over a button on the diaphragm.



An ingenious puncture repair outfit with a new plug.

The outfit consists of a tool to insert the plug in punctures and the plug itself which differs from all others in that the stem is flat and the head round. Small punctures are made into tiny slits with a knife, after which the plug is inserted with the tool which first pushes the plug through the slit, then turns it and withdraws the stem. The tube being larger than the slit, and elongated when inserted, expands when in place and fills the hole.

NEW IDEAS IN AUTOMOBILE ACCESSORIES

The Heavens in January

Some Notes on the Planets and Their Satellites

By Henry Norris Russell, Ph.D.

THE comets whose discovery and motions have occupied so much of our space of late are now all well on their way outward from the Sun, and with one exception, are no longer visible in small instruments. Westphal's comet alone remains in the northern sky—its computed position being right ascension 21 hours 25 minutes, declination 57 degrees 50 minutes north on December 31st and 22 hours 10 minutes, 64 degrees 44 minutes on January 12th. It is now about 125 million miles from the Sun and one hundred million from the Earth, and, theoretically, should be about one third as bright as in November, and should fade away slowly. But the actual brightness of a comet is a capricious thing, for, unlike a planet, it shines by its own light. It is certain that the comet is stirred up to shine in some way by the action of the Sun's radiation upon it; but the nature of this action is not yet well understood, and the brightness, and even the apparent size and shape of a comet, often vary greatly in a short time.

Westphal's comet has given a good example of this. In October it was conspicuous in a small telescope. Early in November, however, as Prof Barnard described it, "it simply went to pieces," becoming a faint, vague, elongated mass of feeble light some two minutes of arc in diameter, and since then it has been faint. There is no longer any chance of its becoming visible to the naked eye at this return, but unless it continues to grow unaccountably fainter, it should be telescopically visible for some time to come.

The principal interest this month shifts to the planets Mars and Saturn, which are splendidly placed for observation in the evening sky. Saturn is in Taurus, about 8 degrees northeast of Aldebaran at the beginning of the year, and moves about 1⅓ degree westward during January Mars is farther west, in Gemini, not far from Castor and Pollux, and moves some 8 degrees westward during the month.

Both planets are very conspicuous, Saturn shining with a yellow light and appearing a little brighter than Capella, which is, next to Sirius, the brightest star now in sight. Mars is almost equal to Sirius in apparent brightness, and may be recognized at once by his fiery red color.

Saturn is a month past opposition, and is already well up by nightfall. Mars is in opposition on January 5th, and is visible all night long. He is then almost 27 degrees north of the celestial equator, and hence he soon rises high in the sky, and is well observable in the early evening.

Both planets are splendid telescopic objects. Saturn's rings are opened out at their widest, extending beyond the poles of the planet on the north and south. It is on this account that he appears so bright. Seven years ago, when the rings were edgewise toward us, and we received light from the planet's ball alone, he appeared to the eye only half as bright as now

His largest satellite, Titan, which is easily visible with a three-inch telescope, can be found north of the planet on the 4th, west of it on the 8th and so on, its period of revolution being 16 days. When north or south of Saturn its apparent distance from him is twice the extreme length of the rings, and when east or west of him, four and one half times the length of the rings. The satellite's orbit is really almost circular; but since its plane (which coincides with that of the rings) makes an angle of 26 degrees with our line of sight, it appears foreshortened into an ellipse of the same shape as the rings themselves

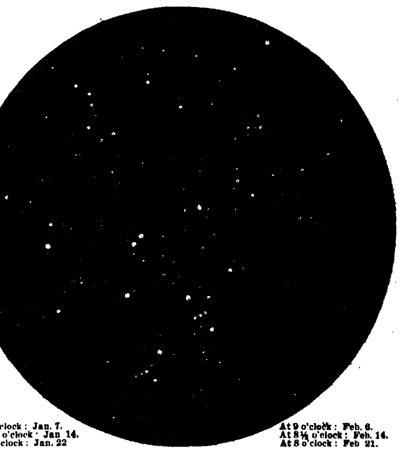
The next nearest satellite to the planet, Rhea, which is a little less than half as far away as Titan, is east of the planet on the evening of the 1st, and at intervals of 4½ days thereafter; but to see it requires a somewhat larger telescope.

A recent bulletin from the Harvard Observatory reports that Prof. Wendell's photometer measurements show that Titan varies in brightness, being 20 per cent fainter when on the farther side of the planet than when on the nearer side. This shows that the satellite always keeps the same side toward the planet, and that this side is darker in color than the other

The remotest satellite, Iapetus, has long been known to vary in a similar manner, but its range is much greater. It is four times as bright when west of the planet than when east of it.

Mars also has satellites—a pair of tiny attendants, very near him—but these are too faint to be seen with any but very large telescopes. The amateur observer must content himself with the study of the more conspicuous markings of the planet's surface, the dark areas, formerly called seas, and the white polar caps. The fact that the dark regions never reflect to us the brilliant patch of sunlight which they would certainly do if they were covered with standing water is a sufficient proof that (at least in the equatorial regions of the planet) they are not really seas.

Prof Barnard, observing with the 60-inch telescope at Mount Wilson during the last opposition, describes their appearance under favorable conditions by saying that the planet "gave one the impression of a globe whose entire surface had been tinted a slight pink color, on which the dark details had been painted with a grayish colored paint, supplied with a very poor brush, producing a shredded or streaky and wispy effect in the darker regions" With a small telescope one can only hope to see the larger outlines of these dark regions, but it is interesting to follow their motion from east to west across the disk as the planet rotates, the change being conspicuous in a couple of hours.



At 11 o'clock: Jan. 7.
At 10½ o'clock: Jan 14.
At 10 o'clock: Jan. 22

At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb 21.

At 9½ o'clock: January 29.

NIGHT SKY: JANUARY AND FEBRUARY

As the period of rotation is 24 hours 37 minutes 23 seconds, we see almost the same side of the planet on one night as we did at the same hour on the night before, but not exactly, the difference in the Martian longitude of the central meridian being 9 degrees. The visible region therefore works slowly backward around the disk, taking forty days to return to its original position.

The conspicuous polar caps, which disappear during the Martian summer, and form again during the winter night, are pretty certainly deposits of snow or hoar-frost. The only other substance of which it is at all reasonable to suppose that they may be composed is carbon dioxide, which solidifies at a temperature of about 80 degrees below zero (Cent.). The temperature of the polar regions of Mars during their long day, though probably a good deal lower than that of the Earth's surface, can hardly be as low as this, and it is therefore probable that the polar caps consist of frozen water in some form. It is, however, not certain whether with the amount of heat which Mars receives from the Sun, its polar regions can ever get quite warm enough to melt snow. But Prof. Newcomb cleared up this difficulty some years ago by recalling the fact that snow, like camphor or other volatile solids, may slowly evaporate into dry air at temperatures considerably below the freezing point. This removes the last objection to the theory that the polar caps of Mars are actually layers of snow. They must be very thin to melt off entirely, or evaporate off, under the feeble rays of a Martian summer, and this accords with the fact that Campbell's observations show the quantity of water vapor in the Martian atmosphere to be very small.

At the present opposition, both the Earth and Sun are near the plane of Mars' equator. We see both the northern and southern polar regions of the planet, very much foreshortened, at opposite sides of the disk. The Martian season corresponds to the beginning of April on our planet. The northern pole is just beginning to catch the sunlight, while the southern one is entering upon its long night. The northern polar cap will, therefore, be of considerable size, while the southern regions will be clear of snow.

The Heavens.

In the latter part of the evening, as our map shows, Saturn will be a little west of the meridian, and Mars a little to the east of it, both being very high in the sky. Orion and Canis Major are below them, due south, and shining brilliantly. Far below them is Argo, whose brightest star, Canopus, second only to Sirius in brilliancy, can be seen on the southern horizon from points south of Virginia. Canis Minor, Leo, and Hydra are the most conspicuous constellations in the east, Ursa Major in the northeast, Draco and Ursa Minor in the north, Cassiopeia in the northwest, and Andromeda and Aries in the west, while Perseus and Auriga are almost overhead.

The Planets.

Mercury is morning star at the beginning of the month, rising rather less than an hour before the Sun. Soon afterward, he disappears from the morning sky, and passes through superior conjunction, behind the Sun, on the 28th, to appear as an evening star next month. Venus, too, is a morning star, but is approaching conjunction, and too near the Sun to be easily seen. On the 18th she is in conjunction with Mercury, and the two planets, which are moving in the same direction in the heavens, are within 2 degrees of one another for several days; but both are too near the Sun to be easily seen.

Mars, as we have already mentioned, is in opposition on the 5th. Though very far north, and thus well placed for observation, he is much farther from us than he was at the oppositions of 1907 and 1909—for then he was in the part of his orbit nearest the Sun when the Earth overtook him, and now he is not far from the remotest part. Jupiter is in conjunction with the Sun on the 20th, and is invisible this month. Saturn is in Taurus, visible until shortly before sunrise, as already described.

Uranus is in conjunction with the Sun on the 28th, and cannot be seen. Neptune is in opposition on the 17th, and is well observable with a telescope. His position in the heavens is as follows:

	R. A.	Dec.
January 1	$7^h\ 57^m\ 4.2^s$	$+20°\ 16'\ 24''$
January 17	$7^h\ 55^m\ 12.9^s$	$+20°\ 21'\ 41''$
February 2	$7^h\ 53^m\ 21.1^s$	$+20°\ 26'\ 59''$

The Moon.

The Moon is in her first quarter at 8 A. M. on the 4th, full at midnight on the 11th, in her last quarter at 7 P. M. on the 18th, and new at 2 A. M. on the 26th. She is nearest us on the 15th, and farthest away on the 3rd and the 31st. In her circuit of the sky she passes near Saturn on the 8th, Mars on the 10th, Neptune on the 11th, and Jupiter, Venus, Mercury and Uranus on the afternoon of the 25th and morning of the 26th, within a few hours of each other. At this time all four planets, the Moon and the Sun, all lie within a circle 7 degrees in diameter.

Almost as this article is sent to press, comes a telegram announcing the discovery of another comet by Delavan at La Plata, who was the first to detect Westphal's comet on its return. On December 17th the new comet was in 3 hours 2 minutes right ascension and 7 degrees 25 minutes south declination and was described as "visible in a large telescope," so that it must be faint.

Princeton University Observatory.

The Wright Automatic Stabilizer for Aeroplanes

Merits and Faults of the Patented Device; How the Actual Stabilizer Differs From That of the Patent

By Carl Dienstbach

THERE are two problems still awaiting a really satisfactory solution, for they block the way to a commercial utilization of all the wonderful achievements in aerial navigation. One of these problems involves the invention of the safe flying machine; the other, the economical docking of the speedy mammoth dirigible. Making the aeroplane safe is largely a matter of providing an efficient stabilizer. It is not without significance that the tenth anniversary of the first power-flight is marked by the grant of an American patent for an automatic stabilizer, invented by none other than the Wright brothers, to whom we owe the creation of the first man-carrying motor-driven aeroplane.

It is also significant that this is only the second innovation in the Wright machine of 1908. It is announced that this apparatus will be soon in practical use.

The first departure from the original Wright type was the adoption of a modified "open work" Blériot tail and rear elevator, and the Farman wheels, rather a poor recompense for the wholesale appropriation by the French of the Wright side control. The Wright stabilizer, described in the patent specification, is very simple. Although the apparatus actually built departs somewhat from the patent, still the principle of the invention as revealed in the patent is retained. One is immediately struck with the simplicity of the apparatus—a simplicity which, paradoxically enough, may be the principal obstacle in the attainment of efficiency. If an automatic stabilizer is intended to supply "mechanical brains," it might be expected to show a greater resemblance to a scientific instrument of precision—such as a gyroscopic compass for example.

This stabilizer really embodies two entirely distinct inventions. On the other hand the theoretical conditions of longitudinal stability are absolutely different from those of transverse stability.

The device for obtaining transverse stability mainly embodies the conception of a stabilizing pendulum and its functions. The pendulum *a* is connected with a threeway valve *b*, which by its movement, admits compressed air from an air tank *c* to a servomotor *d*, or allows it to escape from that motor, or locks it in the cylinder and blocks the piston. By means of a connecting rod *e*, working in a slot, and a windlass *j*, the piston pulls on the interconnected cables *g*, which work the warping mechanism and the vertical rudder. The principal novelties are stops *h*, to check the pendulum. They eliminate erratic swinging, but on the other hand restrict this mechanical mind to signifying only "yes" or "no," like a simple Quaker.

There is no grading of effect. The least swing of the pendulum will set the side control going with its maximum energy. A light puff of wind will thus be counteracted with all the force required for the most severe gust. This seems like borrowing trouble. The tremendous action of the side control, having almost nothing to resist it but the considerable inertia of the wide distribution of weight in a transverse direction, which is sufficient to prolong the action of the mechanism considerably, will impart so much momentum to the heavy machine in rocking it around a longitudinal axis, that in spite of instant reversal of the pendulum control, after the horizontal position has been again attained and passed, it must inevitably overshoot the mark, and come to rest only with its side balance worse disturbed in the opposite direction.

It seems for this reason that the machine's return swing under the reversed action of the pendulum should be more violent than the first, because the second action of the pendulum must last longer than the first. And so on should the rocking of the machine become increasingly worse, just as in a very high flower vase with a small base, if it once begins to rock, will increase the amplitude of the swings until they move the center of gravity beyond the support, and the vessel topples over. But there is one compensating action in this process. If an aeroplane is thrown out of side balance by an unwarranted action of the control, it will begin to slide down sideways, just as surely as when the loss of balance is due to unresisted wind force. This sliding in turn will reverse the pendulum's action even before it has brought the machine back to (and fatally beyond) a horizontal position. This seems to explain why a newspaper report has it that "in practice the device was promising but required more experimenting." Certainly its action is not so simple in theory as stated in the patent specification. It could easily be made to work more elastically if a spring were added to restrain the all too ready pendulum.

In real gusts or in turning the side slip becomes detrimental instead of beneficial, causing the mechanism to share the inherent fault of all pendulum devices which was pointed out so clearly by Prof. Prandtl. Probably this device may be developed to supplant the pilot only in calm air, and as it moves the control only by friction it can be overruled in gusts by the ordinary hand lever *i*. It will then resemble Moreau's "aerostable," which also depends on pendulum action in calm air but which is controlled by hand in gusts, the automatic action, however, being graded in exact proportion to the disturbance to be resisted.

The invention may then become only a labor saving device for the pilot—as much of a convenience, as though in a teaching machine with double controls, of which one set can be mechanically overruled by the other, a master pilot had his passenger do the ordinary stabilising and saved his own energy for emergencies.

As the horizontal rudder for maintaining the longitudinal stability is worked by an identical servomotor 1, with connecting rod 2 and windlass 3, which is likewise controlled by a threeway valve 4, defects similar to those of the automatic side control might be expected, although the inventors themselves considered a pendulum, which is affected by any change of speed just as much as by changes of inclination, unsuited for controlling longitudinal stability, and substituted for it what the French would call an "*empennage déplacée.*"

A small plane 5, is mounted at a different angle from the main aeroplanes. Like a non-lifting tail it will receive air pressure from above or below whenever the main planes change their angle of attack, and, as it is allowed to yield by the parallel motion frame 6, which is connected with the threeway valve 4 by a rod and lever 7, it will resist any such change in the angle of attack, not like a tail, by its own surface and leverage, but by the machinery it controls, which machinery promptly sets in motion the horizontal rudder. Apart from such faults as easily ensue from inadequate action of the machinery, such a stabilizing plane is naturally subject to all inherent defects of a stabilizing tail, with one praiseworthy exception.

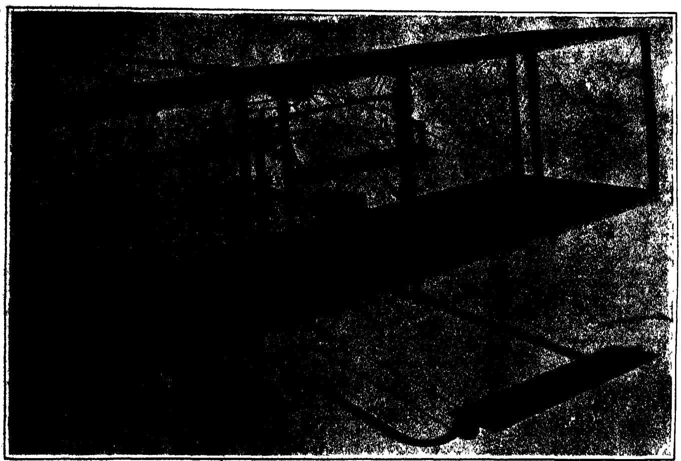
Like the use of a tail it fundamentally presupposes that the stabilizing surface is washed by the same airstream as the main planes. The "internal work of the wind" defeats this theory. But the stabilizing plane here shown has the one great advantage over a tail of being next to the main planes and much more subject to the same up and down trends of the relative wind. Nevertheless, the difference of size remains a stumbling block, just because this plane's mechanical action is so much more violent and sudden than the simple stabilizing effect of a tail.

What we call air pressure on an aeroplane is only an abstract notion because we imagine it as uniform. In reality it is an average of many different and changing impulses on the several units of surface. Consequently, a small plane, even close to a large plane, will not be, as a whole, affected in the same way by the same wind as a large one, as soon as the "internal work of the wind" becomes at all energetic. This is dangerous, if (just as in the case of the pendulum) a slight movement of the plane will set the rudder in full operation. A purely local change of trend in the wind, which does not affect the main planes at all, may thus result in a violent stabilizing action for which there is neither an object nor a resistance. This will start the same increasing oscillations as the pendulum action, softened (in comparison with the lateral stabilizer) by the concentration of weight in a longitudinal direction, but aggravated by the plane, unlike a pendulum, its action not being beneficially reversed by the change of speed resulting from the alternating gliding down and climbing during longitudinal oscillations.

A rather needed remedy would seem to be the addition of a spring restraining the too ready movements of the stabilizing surface and grading its effect. This would represent a very curious analogy to the cushioning of a Pénaud tail, as practised by Chanute-Herring and Langley-Manly for the identical purpose of making a small stabilizing surface less subject to the "internal work of the wind." Manly and Herring have both stated to the writer, each without knowing of the other's experience, that properly adjusting the tension of the spring was the essential thing. A spring would also do away with the need of the counterbalancing weight 8, and its harmful inertia and momentum.

The proper refinement of the device would seem to consist in employing not one comparatively large stabil-

(*Concluded on page 36.*)



The letters refer to the mechanical elements of the transverse stabilizer; the numerals to those of the fore and aft stabilizer. The pendulum rod *A* is connected with a threeway valve *B*, which admits compressed air from a tank *C* to a servo motor *D*, or allows the air to escape from that motor, or locks the air in the cylinder to block the piston. By means of a connecting rod *E*, working in a slot, and a windlass *J*, the piston pulls on the cables *G*, which warp the wings and operate the rear rudder simultaneously. Stops *H* limit the swing of the pendulum. The horizontal rudder for maintaining longitudinal stability is worked by a servo motor 1, connecting rod 2, windlass 3, and threeway valve 4. A small plane 5, mounted at a different angle from the main planes is allowed to yield by the parallel motion frame 6, connected with the threeway valve 4 by a rod and lever 7.

The device invented by the Wrights to balance a flying machine automatically.

Modern Electric Engine Starters and Electric Illumination Systems

Their Significance in Modern Motor Car Construction

By Walter Bannard, M.E.

> *When, more than a dozen years ago, a man with the germ of an idea succeeded in attaching a small electric motor to a heavy gas engine in a way that would permit the engine to be started quickly and easily, he sensed the feeling that some day would come to the owners and operators of motor cars; he expressed in a crude way the thought that in some enlightened day, owners of cars would demand that all the labor attendant upon their operation be eliminated; that the engine be made "self starting" in so far as that is possible. It was the beginning of the mechanical engine starter era. Since then, the mammoth automobile industry has swept fairly rapidly through compressed air starters, ignition starters (under which head come the various acetylene gas and gasoline vapor devices), spring starters and the numerous mechanical contrivances designed to render easier the attainment of the initial explosions by placing at the driver's hand, as he sits in his seat behind the steering wheel, some means whereby he can rotate the crankshaft of his engine. In this article the development of the starter is traced and its importance estimated.*—Editor.

IT was not until two years ago that the engine starting movement gained any real impetus, when practically without exception car manufacturers took to the acetylene starter about as quickly and easily as a duck takes to water; they literally stampeded for it, and for a time all other types of starters dropped almost completely out of sight. But the acetylene starter was inadequate for the reason that it was not 100 per cent efficient. Few car owners were willing to accept its approximate 98 per cent of efficiency as representing a true solution of the engine starting problem. Hence, manufacturers cast about for something else.

The insistent public demand, stimulated by the promise of the acetylene starter, practically forced action which might have been delayed for a considerable period. The compressed air type of starter offered possibilities and a number of manufacturers proceeded to substitute it for the acetylene starter, and, but for the budding of another popular clamor, which once more turned the tide of inventors' efforts, pneumatic devices might now have been in the majority.

But on the head of the demand for starters there came an equally insistent demand for electric lights as representing still another step toward the elimination of the operator's labor, and a palpable improvement over the old style oil lamps. The necessity for providing a dynamo with which to charge the accumulator necessary for electric illumination immediately suggested, or rather reopened the dormant suggestion of a dozen years back, of providing for electrically starting the gasoline engine.

With both dynamo and storage battery in the equipment of the car, it was but a short step to add a tiny electric motor for starting. Hence, passing over the trials and tribulations of those who sought to perfect the application, and succeeded in doing so, the electric engine starter, after scarcely more than two years development, now is supreme. There is scarcely a car manufactured—large or small—that is not fitted with an electric engine starter, and if proof is needed that it has ousted all other types, it need only be added that three very prominent makers of comparatively high-priced cars who always have pinned their faith to the pneumatic starter, have for the first time this year cast it out in favor of electric systems.

Advantages of the Automatic Starter.

It is scarcely necessary to enlarge upon the advantages of the engine starter, quite regardless of its kind: The elimination of manual labor and the attendant risk of injury to the operator; the ability to start the power plant from the driver's seat with all the controls within reach of the man in control; the wiping out of the hazard of motors that stall in front of fast-moving railroad trains or other vehicles; in short, the *safety* of the device. All this is fairly well known.

Nor need any one of average intelligence look at the modern electric system askance as being, perhaps, beyond the ken of the man in the street. Thanks to the efforts of designers, it is, in truth, beautifully simple. It seldom, if ever, requires attention. Therein lies its value. The electric lighting and engine starting system in the abstract includes a storage battery of three, six or nine cells—seldom more—a self-regulation charging generator, which is quite automatic in action, and the starting motor.

The battery, as a rule, is carried in a special frame beneath the body of the car (Fig. 2), though it may be carried on a running board, under a seat or in any other convenient place. In determining its capacity, it is a general practice to consider the necessity for carrying the full lamp load with the engine idle for a given length of time. It must be capable of delivering a heavy current for short periods, as when starting the engine. One well known engine starter of the six-volt type, for example, draws 100 amperes when rotating at 200 revolutions a minute the crankshaft of a four-cylinder engine whose cylinders measure 3¾ by 4½ inches; the gear ratio is seven turns of the starter to one of the engine crankshaft.

The generator must be self regulating and there are several ways in which this may be accomplished. One method that is followed by several well-known makers is to govern the speed of the armature, using a centrifugal device operating a friction clutch; this has been found to work well. Other methods consist of varying the resistance of the field, to govern output, either in the method of winding the machine, or electro-mechanically by means of solenoids, centrifugal devices (Fig. 1) or magnets, a common way being to rely upon the resistance of a pile of carbon disks which are held tightly together under the action of a spring and drawn slightly apart by a magnet inserted in the field circuit (Fig. 8). In one machine, the increasing resistance of iron wire under heat is relied upon to shunt part of the current through what is styled a "bucking coil" when the speed of the armature increases beyond a predetermined limit. To prevent the battery discharging itself through the generator when the engine is stopped, the electro-mechanical cut-out (Fig. 8) is most in use, though some makers use centrifugal devices; the latter are uncommon, however.

Owing to the inherent characteristics of the series wound electric motor, it is peculiarly suited to starter work, and this type is used exclusively. Its most prominent feature and the one that is most valuable is that the torque increases with the load up to a certain limit. Obviously the motor must be wound to stand heavy overloads and must have quick acceleration. Withal it must be as light as possible and occupy the minimum space.

Broadly, electric lighting and engine starting systems can be divided into three general classes, as follows: (1) One unit in which the generator and starting motor are combined in a single machine (Fig. 4); (2) two units in which generator and motor are separately mounted (Fig. 5); (3) single unit, flywheel type, in which motor and generator are combined and the whole mounted with, or in place of, the engine flywheel (Figs. 3, 6 and 9).

Each type has its advantages. Thus, for instance, the two-unit type provides for nearly equal weight distribution of the elements and eliminates the possibility of the derangement of one disrupting the service of the other, though it makes necessary separate mounting and driving. The single unit type centralizes equipment, simplifies mounting and driving, but is open to the objection that both lighting and starting functions may be deranged through failure of either. The flywheel type does away with the necessity for gearing, but must be built into place at the factory of the car maker.

In two-unit outfits there are several ways in which the dynamo can be driven, the preferred method being through the valve gearing either by separate shaft and direct connection (Figs. 10, 11 and 12) or from the camshaft by "silent" chain. The characteristics of the machine largely determine the method, some machines requiring to be driven at comparatively high speed and some at crankshaft speed. Alternative methods are to gear the generator to the propeller shaft by chain or belt, or to drive it from the crankshaft by either chain or belt (Fig. 10). Obviously, where the generator and the starting motor are combined a drive more positive than that afforded by a belt must be provided.

The mounting and driving of the separate starting motor presents other difficulties, for it is plain that there must be some means of disconnecting it *after* it has performed its function. One of the simplest methods is to connect it to the engine through the intermediary of gearing cut in the periphery of the flywheel (Figs. 5 and 14). This method entails the necessity for a sliding pinion on the armature shaft and a means for engaging and disengaging it. Generally, the starting switch and the gear shifting mechanism are interconnected and a supplementary contact provided in the switch to rotate the armature shaft at low speed, first, to facilitate the engagement of the gears. Full depression of the starting lever engages the gears and throws the full current of the battery through the motor. When the engine starts, release of the lever disengages the gears, or else they are automatically "kicked" out of engagement when the peripheral speed of the flywheel exceeds the speed of the driving on the armature shaft.

In one starting motor (Fig. 5) the armature is movable longitudinally and the armature pinion is engaged with the flywheel gear through the solenoid action of the field on the armature when the current is thrown on; a spring disengages the gears. These methods apply, of course, only where the starting motor and generator are separate units.

Other methods include direct connection by shaft through the timing gear train with the interposition of an over-running clutch which lets go when the speed of the driven shaft exceeds that of the driving shaft; or a chain running over a sprocket on the crankshaft or on the propeller or clutch shafts (Fig. 4) may take the place of the shaft drive to the front gear train, the over-running clutch remaining as a matter of course. Latterly, some attempt has been made to incorporate the combined starting motor and generator in the transmission gearset, the connection being through integral, inclosed gearing. This method places the electric unit in a rather awkward position in so far as accessibility is concerned, and has not been largely adopted as yet.

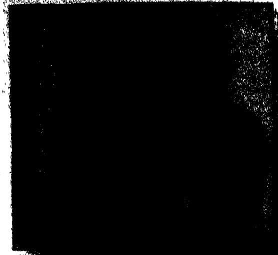
Where the motor and the generator form a single unit positive connection is essential. In this case, the unit is a motor when current is passed through it from the battery, but immediately the gasoline engine takes up its own cycle of operations and drives the motor, it automatically becomes a generator and charges the battery. Generally, an automatic cut-off (Fig. 8) to disconnect the battery from the generator when the engine is stopped is provided, though in one system none is provided. With this latter machine it is impossible for the gasoline engine to be stalled, for instantly the output of the generator drops below that of the battery—as when the engine stops—the generator becomes a motor and drives the gasoline engine. The connection between the electrical unit and the battery is manually made and broken.

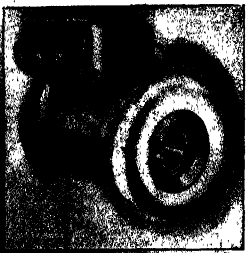
In conclusion, the electric engine starter undoubtedly is with us to stay. It has been perfected and refined and its operation rendered so automatic that not even a superficial knowledge of matters electrical is required properly to care for it. Just what the future will bring forth, no man can say. At present, manufacturers are bending their energies to increase efficiency by lightening apparatus, and in the not far distant future it is likely that we shall see all classes of cars electrically lighted and started, from the heaviest to the very lightest—not even excepting the so-called "cyclecar."

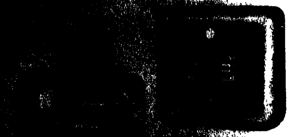
The Current Supplement

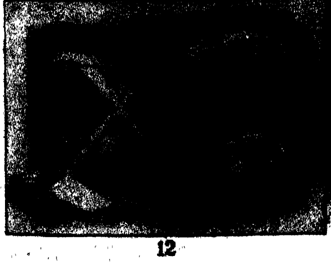
IN this week's issue of our Supplement Prof. Bateson discusses the subject of heredity with special reference to physical and mental taints.—Charles F. Fraasa, Jr., gives instructions for the construction of a fifty watt transformer.—Prof. Harker writes on the origin of solar electricity.—Dr. J. R. Williams gives us a study of the use of ice and other means of preserving food in the house.—Prof. H. L. Jameson writes on "Biological Science and the Pearling Industry."—The Hardening and Tempering of Steel is the subject of an illustrated article.—Alexander Gracie in his recent James Forrest lecture has brought forward many interesting data on present and past conditions and cost of ocean transport. The salient points of this lecture are summarised for our readers.

Capt. Amundsen, during his recent visit to Copenhagen, announced that he would sail from San Francisco on his north polar journey next June. His vessel, the "Fram," carries a crew of fourteen men, besides the leader and the scientific staff. Provisions for seven years will be taken, though Amundsen hopes to complete his undertaking in four. It is hoped to enter the ice drift in September. The equipment will include two aeroplanes, which Amundsen has bought in the United States. One of the staff recently took a course in aeronautics in France, and Amundsen will himself take a course before starting north. The Norwegian government has contributed 170,000 kroner ($45,560) toward the expedition.









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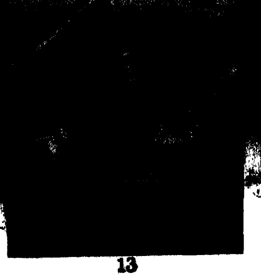

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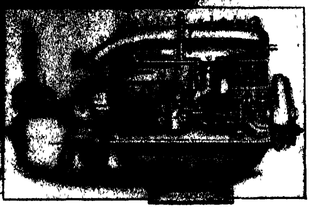

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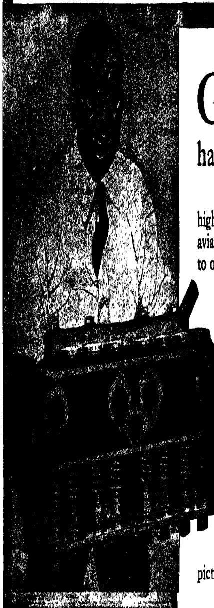
FIG. 1.—*Generator Regulating Method.* A centrifugal device draws an arm over a series of contacts inserting resistance in the field as the speed of the armature is increased, thus maintaining the output practically constant. FIG. 2.—*Storage Battery Mounted Under Floor Boards.* FIG. 3.—*Flywheel Type Motor-generator in Place.* In this type of combined electric lighting and engine starting system the combined motor and generator takes the place of the usual engine flywheel. FIG. 4.—*Bottom View of Chassis Showing Installation of Starting Motor.* The motor is mounted adjacent to the transmission gearset and starts the engine through gears mounted on the clutch shaft. FIG. 5.—*A Typical Modern Electric Lighting and Starting Installation.* Right and left sides of motor showing generator mounting and drive through chain to the camshaft. The armature of the starting motor slides longitudinally, like the core of a solenoid, and engages its pinion with the flywheel gearing; a spring returns the armature to its normal position. FIG. 6.—*Armature of a Flywheel Motor Generator.* FIG. 7.—*Two-unit Lighting and Starting System Complete.* The generator is driven from the timing gear train and the starting motor is geared to the flywheel of the engine. FIG. 8.—*Combined Regulator and Cut-out.* A magnet, in series with the field windings, tends to separate the carbon disks, normally held together by a spring, as the output of the generator increases, thus increasing the resistance of the pile and lowering the output of the generator. The cut-out is an electro-magnetic device to disconnect battery and generator when the engine is stopped. FIG. 9.—*Flywheel Type Motor-generator Disassembled.* Reading from left to right the parts are as follows: Aluminium case with field coils; armature with commutator; brush carrier and brushes; aluminum dust ring. FIG. 10.—*Generator Driven by Chain from the Engine Crank Shaft.* FIG. 11.—*Installation of Generator Driven from Timing Gear Train.* FIG. 12.—*Generator Direct Connected to Timing Gears.* FIG. 13.—*Controller for Both Lighting and Starting Circuits.* FIG. 14.—*Mounting of Combined Lighting and Starting Unit.* As a generator the unit is driven through the pump shaft from the timing gear train; but as a motor, the unit drives the gasoline engine through the intermediary of gearing on the periphery of the flywheel. The operations are automatic.

NEW ELECTRIC STARTERS AND IGNITION DEVICES

"A Mechanical Masterpiece" says Glenn Curtiss



GLENN CURTISS, perhaps the greatest light-engine expert in the world, has just bought a Jeffery Six.

Mr. Curtiss knows what has been accomplished by the use of high-speed light motors. Some of his own greater achievements in aviation have taken place in Europe. He has had ample opportunity to observe the progress made there in light-weight motor construction.

He has seen this idea replace all others in European automobile engine development.

So when Mr. Curtiss buys a Jeffery—the first American car to recognize and adopt the light, high-speed monobloc motor—it is the endorsement of an expert. "The Jeffery," Mr. Curtiss says, "incorporates the latest European practice throughout."

He was one of the first to make inquiry about this remarkable car when the announcement was made. Then he took a demonstration and immediately sent the Thomas B. Jeffery Company a telegram. The text of this telegram is quoted complete on the opposite page under Mr. Curtiss' picture. His Jeffery Six was delivered to him on November 29, 1913.

The light, economical motor used on European cars has proved its correctness in millions of miles of continental running. The heavy motors of some American makers have demonstrated beyond doubt through their costly maintenance expense, their unfitness for cars of moderate price. But these manufacturers cling to the use of the heavy type of motor.

They continue to use it because until now the American motor car buyer has not realized that motor power was not dependent upon motor bulk; and because their plants are equipped to build this type of motor.

We cheerfully acknowledge the supremacy of the light European motor—and we hasten to adopt that which means better service and greater satisfaction to the owners of Jeffery cars.

We are in business to produce the automobile that you want—and we have accomplished that in the Jeffery Four at $1550.

You demanded economy, speed, stamina, lightness and comfort. We built the Jeffery Four to that order.

And believing in that business law which rewards the fit against the unfit, we feel sure that the Jeffery Four will in a very short time supplant a great many of the heavy American models.

Already we have sold hundreds of cars to men who could pay more, but who found they could not buy better.

They had declared themselves for flexibility. Jeffery gave them a car that would make 40 miles an hour within 20 seconds, from a standing start.

They had declared themselves for lightness. Jeffery produced a car that weighs but 2870 pounds.

They had declared themselves for power. Jeffery offered a light, fast motor that develops 42 horsepower.

They asked economy. Jeffery motors are high efficiency motors; burning little gas; burning it completely, quickly and economically.

Jeffery lightness (2870) means a long life to tires; often six or eight thousand miles per set.

A Jeffery horsepower has to pull but 60 pounds of car—other motors have to pull from 80 to 100.

And above all, the discriminating buyer who has owned other cars, and had discovered the sacrifices necessary to low price, demanded comfort.

"It can't be done," said Jeffery dealers—

"It is impossible," said the owners whose specifications we set out to incorporate.

Jeffery did it.

And because he proved that we had met every demand for lightness, speed, power, economy and comfort, the result is mighty gratifying to us.

The best dealers everywhere in the country are organizing new companies and dropping other lines to sell this car, and the motor car buying public who have been paying much more for big, heavy, uneconomical cars, and much less for cheap, uncomfortable cars, are driving Jeffery cars this season.

The Jeffery Six is a duplicate of the wonderful Jeffery Four, except for size. The cylinders are cast in pairs. This car, which sells at $2,250, is in a great many ways as remarkable among Sixes as its smaller brother is among the Fours. We built it for those who will drive nothing but a Jeffrey car, but who prefer a Six. It is light—actual scale weight, 3,570 pounds, with full equipment. We made it luxurious and beautiful without making it extravagant. We know that a better Six cannot be built.

The motor—3¾ x 5¼—develops 48 horsepower. The bearings are imported annular ball throughout. The ignition is Bosch Duplex and the starting and lighting system is the U-S-L of course. Wheel base, 128 inches, and wheels 36x4½—on enclosed cars 37x5—full floating rear axle. Rayfield carburetor, Warner autometer, ammeter, engine driven power tire pump, Rothschild body with extra wide doors and low, deep seats. This car is made with five-passenger touring or two-passenger roadster body at $2250; six-passenger at $2300; Sedan, five-passenger, $3250, and Limousine, at $3700.

The Thomas B. Jeffery Company
Main Office and Works, Kenosha, Wisconsin

Specifications of Jeffery Four $1550

U-S-L starting and lighting, without chains, gears, bearings or belts. Left hand drive and center control.

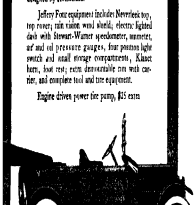
Imported annular ball bearings throughout; Spicer universal joints; combination force feed and splash oiling system. (Speed up to forty miles an hour, shut off your engine and coast half a mile.) Leather ring universal between clutch and transmission; four forward speed transmission—the lightest and easiest to operate

High grade, full floating type rear axle, on imported annular ball bearings—a delight to the motor wise. Vanadium steel rear axle drive shafts, front axles, springs and steering knuckles.

Bosch duplex ignition; Rayfield carburetor; pressure feed gasoline tank with gauges on tank and dash; demountable rim; advanced type of body designed by Rothschild.

Jeffery Four equipment includes Neverleek top, top cover; rain vision wind shield; electric lighted dash with Stewart-Warner speedometer, ammeter, air and oil pressure gauges, four position light switch and small storage compartments, Klaxet horn, foot rest; extra demountable rim with carrier, and complete tool and tire equipment.

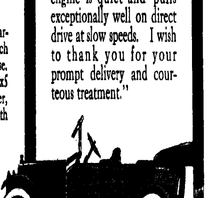
Engine driven power tire pump, $25 extra



Jeffery Four $1550

Glenn Curtiss Says:

"I have been running the new Jeffery Six, and I am glad to report to you that the car is as good as it looks and a mechanical masterpiece. The machine is up-to-date in every respect and incorporates the latest European practice throughout. It has plenty of power and speed and is easy riding and very easy to handle. The engine is quiet and pulls exceptionally well on direct drive at slow speeds. I wish to thank you for your prompt delivery and courteous treatment."



Jeffery Six $2250

Making the Automobile Comfortable in Winter

By George Petman

IN at least one respect the motor world of to-day is vastly different from the motor world of yesterday. Whereas not more than a year or so ago the motorist who braved every summer storm, packed his car away —almost literally in moth balls—during the winter months when Jack Frost held sway, now drives the year around. It is a tendency that is becoming more and more marked each year. In a great many cases those who purchase cars when the new models come through in the fall or in the late summer, purchase two bodies to fit the one chassis—an open touring body for use during the remainder of the summer and a closed body, or either the limousine or landaulet or coupé type for use in the winter months. But even where two bodies are not purchased the all-year motorist is becoming ever more prominent, and there are abundant reasons why this should be so.

In the first place, the open car of a few years ago was an open one in very truth—it afforded little protection to those who occupied the tonneau seats and even less to the driver and his "left hand man." The day of the partly closed forward compartment had not yet dawned. To tour in winter then meant swathing one's self in layer upon layer of heavy robes until the *tout ensemble* presented more the appearance of a mummy than of anything else. And even when it was possible to prevent chills chasing themselves up and down one's back, real comfort still perched alluringly on the horizon.

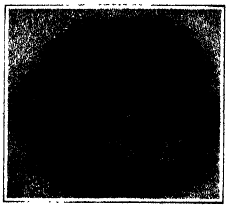
With the advent of the closed front touring body, conditions were very much improved. Chill blasts from the sides were effectually stopped, and at least one layer of robes was rendered unnecessary Later, manufacturers saw light in the deep scuttle dash that so long had been in vogue in England and on the Continent, and it slowly commenced to appear on American cars. Now, there scarcely is a car marketed that has not a scuttle dash, and certainly there are none that are minus front doors

Strangely enough, however, little attention has been paid to the necessity for increasing the comfort of those who ride in the tonneau seats. Although the driver and the person who sits beside him may now ride in comparative comfort when the wintry winds do blow, those who ride in the tonneau still are constrained to disguise themselves with robes and furs. And this is all the more remarkable by reason of the fact that of the two seats, the tonneau seat is by far the colder. No doubt this is due in part to the fact that little or no heat from the engine penetrates to the back of the car. Another factor which undoubtedly contributes to the chill atmosphere that pervades the tonneau of most cars is that the windshield and the scuttle and the lines of the body tend to produce eddy currents which are swept over the front seats and down into the space between the back of the driver's seat and the back of the car.

As far as is known, no manufacturer thus far has made any provision for warming the tonneau of his car during cold weather, though manifestly there is a crying need for some device that will contribute to the comfort of passengers in the rear seats. A simple exhaust gas heater or a radiator receiving its warmth from the water in the engine jackets would serve the purpose excellently, and either method has the advantage that it is neither expensive to install nor to maintain. To warm the driver's compartment is considerably simpler than to warm the tonneau, of course, and this probably accounts for the greater attention that has been paid to the comfort of the driver. The simplest method of providing warmth is to insert a small grating in the floorboard and to provide it with a means whereby the openings can be varied to suit the temperature requirements of the driver. Heat generated by the engine then would be forced through the grating by the draft created by the cooling fan, and as exhaust products cannot escape beneath the engine hood no objection can be found to this method.

Devices of the kind tend to maintain only the lower extremities of the body at their normal temperature, of course, and as it is absolutely essential that the driver's hands be on the steering wheel during the whole of the time the vehicle is in motion, some other means of keeping his hands warm must be adopted. For this purpose there has been placed on the market an exhaust gas heated steering wheel, though it has not come into very great use owing to its complication, slight as it is in fact. Much preferred are the electrically heated steering wheels that are available. These devices operate on exactly the same principle as the ordinary electric heater except that being considerably smaller, they consume very much less current. In one type, the wheel complete is supplied by the maker and may be placed at the top of the steering post instead of the regular wheel. In another type, two grips containing the heating units lace to the existing wheel and therefore can be removed when not needed. Another device that only recently has come into fairly general use—as a matter of fact, all these devices are new—is the electrically heated glove a picture of which is reproduced herewith. The gloves contain the heating units coiled around inside the fingers and terminating in contacts so arranged that a natural grip on the steering wheel brings them against other contacts (on the wheel) connected with the source of energy which usually is the lighting storage battery. Thus, shifting the hands slightly disturbs the connection and permits the gloves to cool slightly in case their temperature becomes too high for comfort.

An electrically heated glove and heating units laced to wheel.



Electrically heated steering wheel wound with heating coils.

Electrically heated shoes—or overshoes—have yet to put in an appearance, though the necessity is not as great for the reason, already made plain, that sufficient heat to keep the driver's feet warm can be obtained from the engine. But to those who ride in the tonneau they would prove a boon indeed.

Lessening the Fuel Cost of Motors

By the Paris Correspondent of the Scientific American

SHOULD the comparatively valueless naphthalene come into general use for internal combustion motors, it will almost work a revolution in the cost of fuel in this most extensive field, so that the following account of recent tests made with the combustible in France should prove of interest. It is given by M. Ventou-Duclaux, a prominent member of the Automobile Club technical commission, and an authority on all such subjects. The tests were made upon a Renault motor car of the taxi-auto type, the motor having been transformed for the present use, it being a 12 horsepower 2 cylinder, 102 millimeters bore and 120 stroke. The special devices for naphthalene fuel were the result of two years study by Engineer G. Mohr, and they are shown in the illustrations.

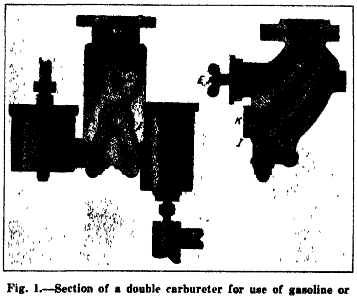


Fig. 1.—Section of a double carbureter for use of gasoline or naphthalene.

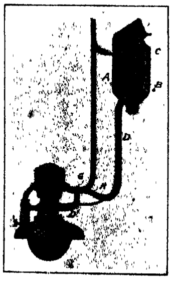


Fig. 2.—Apparatus for liquefying naphthalene.

The naphthalene is melted in a vessel heated by the exhaust gases of the motor (Fig. 2), and to this end the exhaust pipe is made up in a worm tube inside the vessel *A*. Inside is a filter *C* of wire gauze, into which the solid naphthalene is placed, thus retaining solid particles. When melted it runs down by the small tube *B*, which lies close to the hot exhaust pipe *D* so as to allow the naphthalene to reach the carbureter in the melted state. The carbureter is also kept hot by the exhaust gases by way of D^1 and the circulation of hot gases is regulated by the vanes *G* and *H*.

In Fig. 1 is seen the special carbureter, it being made double for the use of gasoline or naphthalene. On the left is the usual float-feed gasoline carbureter. The second one has also a float. The two spray nozzles *I* and I^1 work within a common chamber *K*, this chamber being placed between the jacket *L* having hot gas circulation and a second chamber *S* above, for extra air inlet. The naphthalene spray nozzle is seen at *I*, and air is drawn in for the mixture at *K*. Extra air is admitted in *S* by working the screw *E*.

The combustible used in this case is crude naphthalene whose price in the region of Paris is $1.20 per 100 kilogrammes (220.5 pounds). The following tests with the automobile were made under the direction of the Arts and Crafts Institution of Paris (Conservatoire des Arts et Metiers) and took place on the road between St. Germain and Vernon, on a distance of 52.7 kilometers (32.74 miles) each way, or a total of 105.4 kilometers (65.5 miles). The motor had been started up by gasoline a few minutes beforehand, so that the run could be made on the other fuel alone. The following results were obtained: Duration of test, 3 hours 19 minutes 30 seconds; stops (motor stopped), 15 minutes 30 seconds; net time of test, 3 hours 4 minutes; distance covered, 65.5 miles; state of road, good macadam route with average grades. Mean speed, 34.4 kilometers per hour (21.4 miles); highest speed taken (upon 1 kilometer: 0.62 mile), 42.3 kilometers per hour (26.3 miles); consumption of naphthalene, 14.906 kilogrammes (32.95 pounds).

From the above figures, the consumption of fuel is 14.228 kilogrammes (31.30 pounds) for 100 kilometers (62 1 miles). As regards working of the motor, the following favorable observations were made. At the beginning of the test the motor was started up without difficulty with naphthalene as fuel, after the use of gasoline in the cylinders. During the trial the motor ran regularly as usual and no failures or shocks were noted. After each stop, the motor could be started up easily without using gasoline. At the exhaust there is little or no smoke, except in the up-grades. On the next day it was found that the motor was clean inside and in good working shape, without deposits. It is specially noticed that there were no deposits of naphthalene in the crank-box. A second test was made to show the time needed to start up the motor. With the motor cold, it was started on gasoline, and after 13 minutes 37 seconds it could be run on the other fuel. At this time it was seen that the solid material in the chamber was not all melted. The motor was stopped during ten minutes and was then able to start upon naphthalene without difficulty. With a 16-minute stop it was required to use gasoline in order to start again.

The figures given show that the cost of fuel on a basis of 100 kilometers is: 14.228 × 0.06 = 0.85 franc (16.5 cents), or for 100 miles, $0.28. By adding the small amount of gasoline used, this can amount to 1.00 franc, or even less ($0.32 per 100 miles), while the same motor would have consumed 10 liters (2.64 gallons) of gasoline, representing a cost for 100 kilometers of 5 francs (or for 100 miles, $1.60). The difference between these figures will show the great economy realized. It is interesting to note that the *ensemble* of motor, carburetor and heating device does not reach more than 22 pounds per horse-power. The present tests allow of predicting other applications of the new fuel, such as for power wagons especially, and it may prove to be of great use in this field in cases where the power wagon is to transport material having a low value. For use in stationary engines it will also be available, and the cost for power will now be only 0.4 cent per horse-power hour. Fire risk will now be much less, for the gasoline tank is a very small one and besides can be removed when not in use for motor starting.

New Materials for Paper Making

WE are accustomed to regard paper as a thing of very little intrinsic value, and to treat it as one of the negligible details of business. For all that it is one of the most important and necessary articles of modern industry. The report of the Bureau of the Census places it as twenty-first on the list of manufactured products rated according to value. In the year 1909, the value of the paper and paper pulp manufactured in the United States was $267,657,000. This being the year 1913, the value is considerably greater.

Each year finds new uses to which this valuable material may be put, and hence each year the price of paper and of pulp rises. At present the chief source of pulp for the common grades of paper is the wood of certain pine, spruce and fir trees. The supply is limited, and the rate of consumption is increasing so rapidly that the entire supply is threatened with exhaustion in a few decades. Such is the ever-increasing demand for wood pulp that scientific men and inventors have been spurred on to search for substitutes for wood pulp. There can be no doubt that great pecuniary reward will be earned by the man who devises new processes and machinery which will make the paper manufacturer independent of the wood pulp supply.

A material suitable for the paper manufacturer's purpose must first of all yield a fiber that will "felt," in other words a fiber that will interlock and cohere in a homogeneous sheet. Many vegetable substances will meet this requirement, but a second and more practical consideration enters which is not so easily met. The substance must be such that the material from which the fiber is to be extracted may be readily broken up, so as to liberate the fibers. Moreover, the material must be available in sufficient quantity to make manufacture commercially successful. Lastly, the resultant product must be so cheap as to compete successfully with the paper made from wood pulp.

Numerous attempts have been made to employ the various vegetable by-products, such as sugar cane stalks, sugar beet pulp, etc. Until these products can be made into paper at a price of less than 3 cents a pound, there is no immediate hope of commercial success.

Before wood pulp was introduced about forty years ago, straw was largely used to furnish the fiber. But as it was possible to manufacture wood pulp paper at considerably less cost, this source of material was largely abandoned. However, it is quite possible that as soon as the price of wood pulp becomes so great as to make the manufacture of straw pulp profitable, the industry will be revived.

Prof. Reinke of Brunswick, Germany, has recently patented a process for obtaining cellulose from the refuse of tanning factories, especially pea and bean straw, and the straw and trimmings of asparagus. The trimmings, which constitute about 30 per cent of the weight of asparagus as it comes to the factory, decay very rapidly and have hitherto been used almost solely as a fertilizer, although they have been dried and employed as packing material to a small extent. A sort of wrapping paper made from them as an experiment, proved to be unsalable. Flavoring extracts are made from these trimmings, but Prof. Reinke's experiments have proved that the refuse of this industry can also be converted into cellulose. Still larger quantities of cellulose can be produced by heating asparagus straw or after-growth with sulphurous acid or soda lye in autoclaves, under four to six atmospheres pressure for from one hour to three hours. The cellulose is obtained in fiber of various lengths, and can be converted by grinding, washing, treating with permanganate, sulphurous acid, and the like, into material suitable for the production of paper, felt and other cellulose products.

A lucrative cellulose industry might be established by co-operation between growers and canners of asparagus. According to Prof. Reinke the factory trimmings yield 1.8 per cent of cellulose, amounting to about 15 pounds of cellulose per acre, while the asparagus straw (vines) yields 9 per cent, or about 174 pounds of cellulose per acre.

The production of cellulose from pea and bean straw is of great economic importance, because these materials have hitherto been almost worthless. Pea straw is used in small quantities as fodder, but it is usually plowed under. Bean straw is burned, and the ash has little value as fertilizer. Prof. Reinke has obtained cellulose of good quality by macerating both of these materials with lye under pressure. The process is similar to that employed from asparagus, but the product is superior both in quality and in quantity and is suitable for the manufacture of nitro-cellulose, viscose, etc., as well as for paper making. Pea straw yields 24 per cent, bean straw 33 per cent of cellulose, but this difference is more than compensated by the difference in the crop of straw per acre, so that one acre of peas yields 127 pounds, and an acre of beans 116 pounds of cellulose.

It has been proposed to use various weeds, grasses, cornstalks, sugar cane stalks, and many other vegetable matters, to furnish fiber. But in comparison with pulp wood, these materials are still commercially negligible. About forty-five to fifty per cent of the material of the wood can be made into a fiber paper. Ordinary straw yields about forty-five per cent, while cornstalks, grasses, etc., do not generally yield more than 25 per cent.

A recent report by Dr. Frederick Finch Strong on the manufacture of paper from a species of marsh grass, gives promise of a material that may become of commercial importance as the price of paper and wood pulp increases. The source of the fiber is a kind of marsh grass known as "big saw grass." This grows in immense quantities in the everglades of Florida. The largest patch extends over an area of about six hundred square miles. The stalks grow about four feet high, and the blades or leaves grow about an inch wide and up to about six feet in length. The leaf has a very sharp saw edge that cuts the flesh like a razor. It is possible to harvest two or three crops of this grass each year, and it would be very easy to obtain enough of the material to make commercial working successful. The method of preparing this grass for pulping differs from that used in making wood or straw pulp The material is taken *green* and instead of being chemically digested, or ground, it is run through a mechanical digester that strips off the green outer covering and exposes the fibers. Soda or sulphite solution will not attack the green fleshy cover, but as soon as it is removed, the fiber bundles readily disintegrate into fibers under the action of a weak caustic solution and low pressure steam. The fiber that results can be made into a great variety of good papers.

At the February meeting of the London Society of Arts, Beadle and Stevens described Routledge's experiments in the utilization of bamboo fiber for paper making. Raith demonstrated in 1908 that unbleached bamboo pulp could be produced at a cost of about $30 a ton, one third of which sum is required for chemicals, as bamboo canes need a preliminary cleaning in order to enable the product to be bleached well. Beadle and Stevens also mentioned as exceedingly well adapted to paper making, the fibers of *Hedychium coronarium*, the "sweet snow" or "wreath flower," a plant which grows in India, Central and South America, and West Africa

Another fiber-producing plant is a *Cryptostegia*, which is cultivated in the Bahama Islands and attains a height of 13 feet or more in one year. Excellent paper pulp closely resembling that obtained from rags is yielded by *Ponzolria hypolenca*, a plant which grows in German Southeast Africa, but is not cultivated, although it certainly could be grown with profit.

The success of Reinke's experiments with asparagus, pea and bean straw suggests the advisability of applying the same process to other material which is now of little or no value—for example, the fallen leaves of deciduous trees The chlorophyl, carbohydrates and most of the mineral ingredients of the leaves are drawn back into the trunk before the leaves fall. The fallen leaves contain little else than cellulose, which has only slight value as a fertilizer. The toughness of the fibers is proved by the fact that the skeletons of the leaves do no decay until late in winter.

Recently a scheme was proposed in the handling of sugar cane that would allow of the extraction of the sugar, and the utilization of the fibers of the stalks. It was proposed to shred the cane on the plantations into a kind of coarse silage. This shredded material was then to be dried at the plantations, and shipped to the sugar mills, where the paper mill is also located. Here the sugar is to be extracted, and the stalk's material made into paper. But it is found that by the time the planter buys the coal to dry the cane, and pays the cost of transportation, he has paid out more than the fiber is worth. This process loses sight of the fact that cane stalks are used as fuel in sugar mills, thus saving the cost of any other fuel that would have to be employed in extracting the sugar.

A number of inventors have found ways of using the wood of the southern pine in making paper fibers. The wood of these trees is very resinous, and as a consequence the fibers are very hard to digest by the use of any of the well-known methods. By suitable treatment it is possible to break up this resinous binder, extract the pulp and save the resin. It is claimed by some inventors that the resins alone will pay for the cost of the extraction of the fibers, but for all that it seems that these processes cannot compete with the northern wood pulp processes.

A plant has been established in Louisiana to use sawmill shavings. A heavy wrapping paper is manufactured, and the plant saves the by-product of turpentine and resin.

One inventor, C. L. Weiberg (patent No. 1,025,435) has devised a process for utilizing the fibers from banana stems, tobacco, hemp, okra and seagrass, and several inventors have suggested processes for extracting fibers from peat. But the laws of economics are as inflexible as laws of nature, and until the price of the northern wood pulp rises to a higher figure than at present, these processes must wait for commercial development, serving meanwhile little more than reserve processes.

Wireless Telegraphy in the New York Fire Department

ALMOST simultaneously with the successful application of wireless telegraphy to moving trains for signalling and other purposes of communication, comes the announcement of its use in the fire alarm telegraph bureau of a great city with extensive water front and large shipping interests.

A successful test recently has been made of an installation at Fire Headquarters, New York city, whereby an operator at the central station of the telegraph bureau is able to maintain communication with a fleet of fireboats as they proceed about the waters of the harbor in answering an alarm, or when they are in actual service, as, for example, at a ship on fire at anchor. This new equipment involves a simple installation of wireless apparatus at Fire Headquarters in East Sixty-seventh Street, with an operator always on duty and a similar equipment on the fireboats which, so long as they remain at their station, are in touch with the telegraph bureau by the fire alarm telegraph and by telephone As yet the equipment has been provided only for the large fireboat "James Duane," but it has worked so successfully and proved its utility that it doubtless will be extended to others of the fleet of ten fireboats which the city of New York maintains to protect its shipping and the water front.

The apparatus installed has an effective working range of about 25 miles, and is capable of being tuned to any wave length. Just as soon as the fireboat pulls out into the stream to answer an alarm, the operator on board goes to his instruments and establishes communication with headquarters. The fireboats, on account of their great pumping and hose capacity, respond to a large number of alarms from boxes on, or near the water front, and in so doing make trips of considerable length Many of these alarms are inconsequential, or even false, and the first land engine company to arrive often deals with the fire satisfactorily. As soon as the fire is put out, or the false alarm investigated, the officer in charge telegraphs the fact to fire headquarters and this may be within a very few minutes of sending the original alarm. With the new system, if there is no need for the services of a fireboat, the wireless operator at the central telegraph station transmits an order to the boat on its way and it returns to its station, thus obviating the useless journey with the consumption of coal, which is no small item, and also what is more important, the leaving of territory unprotected. This is indeed serious, as one or more fireboats may proceed a considerable distance in answering an alarm of no importance, while in their absence there may be an outbreak of fire where their services are needed. One or two occasions of this kind have occurred in New York within the last year so that the danger is more real than fancied

At a recent demonstration at which a representative of the SCIENTIFIC AMERICAN was present, an alarm of fire from a box at Ninety-sixth Street and West End Avenue was turned in That being a station at which the fireboat was due, the "James Duane" immediately got under way and proceeded out in the stream and up the Hudson River. Ten minutes later the wireless operator at headquarters, as if it had been a false alarm, sent out a message ordering the captain of the "James Duane" to return to quarters and a confirmation of the receipt of this order was immediately received A few minutes later the commanding officer of the fireboat reported to headquarters over the ordinary telephone that his company had returned and that the messages had been received promptly and correctly.

In addition to the usefulness of wireless on the fireboats already suggested, the possibility of receiving wireless messages from ships at sea at fire headquarters and sending out assistance to vessels approaching the port with fires below their hatches, is also to be considered, as well as the summoning of assistance from ships at anchor where fire breaks out suddenly. As now even cargo steamers are generally provided with wireless equipment, it would be possible to summon assistance within a very few moments after a fire is discovered that the crew cannot cope with. Whether the usefulness of wireless on the fireboats protecting our large harbors may lead to their availability for deep sea service is, of course, problematical, but it will be seen that this new adjunct is not without possibilities in this direction.

Tobacco Growing in England.—The experiment of introducing the cultivation of tobacco in England is being carried out by an organization known as the Tobacco Growers' Society under the supervision of an expert from Rothamsted. The principal plantation is in Hampshire, where a large curing barn has been built. Ireland has now about 150 acres under tobacco, and small experiments of the same sort are under way in Scotland and Wales.

A Quick Reference Table for Commercial Motor Vehicle Buyers

A List of American Motor Trucks and Delivery Wagons Arranged According to Carrying Capacity

Compiled by C. Edward Palmer

A BUSINESS man buys a motor truck which, in his opinion, is best suited to handle his particular class of goods. Hence he is usually concerned more with tonnage than with price. In the commercial vehicle table printed on this page, truck manufacturers are, therefore, listed alphabetically with their products and their products are arranged according to tonnage.

Since the majority of gasoline trucks have four-cylinder motors, it has not been considered necessary to provide a separate column in which the number of cylinders is mentioned. Only the tonnage, horse-power and price are given. The most representative models of each manufacturer are listed and the prices, with very few exceptions, include the chassis only. Bodies in a great variety of forms are furnished by the manufacturers at prices ranging from $100 upward.

The majority of truck manufacturers are willing to sell to small merchants on easy payments and to supervise the installation of motor service.

GASOLINE COMMERCIAL VEHICLES

Name of Vehicle.	Name and Address of Manufacturer.	Tons Capacity, Horse-power and Price.						
		Under 1 ton.	1-1½.	2-2½.	3-3½.	4.	5.	6 and over.
A. & R	Abendroth & Root Manufacturing Co , Newburgh, N. Y.				3, 36, $3,500	4, 36, $3,700	5, 53, $4,350	
Adams	Adams Bros Co , Findlay, O		1, 30, $2,100	2, 30, $2,500				
Admiral	Admiral Motor Car Co., St Louis, Mo		1, 25, $1,475					
A I. C	Ice Manufacturing Co , New York City						5, 29, $3,500	
Alter	Cincinnati Motor Manufacturing Co., Cincinnati, O	½, 33, $1,350						
Armleder	Armleder Co , Cincinnati, O		1, 28, $2,200	2½,34, $2,500				
Atterbury	Atterbury Motor Car Co., Buffalo, N Y.	¾, 25, $1,500	1, 30, $2,000	2, 40, $2,650	3, 50, $3,350		5, 50, $4,250	
Autocar	The Autocar Co., Ardmore, Pa		1½,18, $1,650					
Available	Available Truck Co , Chicago, Ill		1, 28, $1,275					
Avery	Avery Co , Peoria, Ill		1½, 40 (Price	s on applicati	on)			
Barker	C L Barker, Norwalk, Conn		1, 35, $2,000					
Beck	Beck & Son, Cedar Rapids, Ia		1½,40, $1,500		3, 50, $1,800			
Best	Durant-Dort Carriage Co , Flint, Mich	½, 13, $750						
Bessemer	Bessemer Motor Truck Co., Grove City, Pa	¾, 22, $1,250	1½,30, $2,100					
Blair	Blair Manufacturing Co., Newark, O.		1½,35, $2,850	2½,40, $3,250	3½,40, $3,750			
Brockway	Brockway Motor Truck Co., Cortland, N Y	½, 20, $900	1½,30, $1,750					
Brown	Brown Commerical Car Co , Peru, Ind.	¾, 23, $1,650	1, 23, $1,850					
Buick	Buick Motor Co., Flint, Mich	½, 15, $1,000	1, 15, $1,125					
Butler	Huselton Motor Co., Butler, Pa.	¾, 30, $1,650						
Casey	The F A Casey Co., Billerica, Mass.		1, 30, $1,650	2½,40, $2,700		4, 40, $3,500		
Chase	Chase Motor Truck Co., Syracuse, N. Y	½, 34, $855	1, 34, $1,200	2, 40, $2,100				
Coleman	Coleman Motor Truck Co , Ilion, N. Y.		1½,—, $1,950	2, —, $2,400				
Commerce	Commerce Motor Car Co , Detroit, Mich	½, 15, $875						
Continental	Continental Truck Manufacturing Co., Superior, Wis.		1½,35, $1,500					
Corbitt	Corbitt Automobile Co., Henderson, N C		1½,23, $2,000					
Couple-Gear	Couple-Gear Wheel Co., Grand Rapids, Mich				3½,24, $4,250	(4 wheel drive	)5,36, $4,850	(4 wheel drive)
Crow Elk-Hart	Crow Motor Car Co , Elkhart, Ind	½, 33, $950						
Crown	Crown Commercial Car Co., Milwaukee, Wis	¾, 26, $1,350	1, 32, $2,300	2, 35, $2,800	3, 40, $3,300	4, 45, $4,000		6, 50, $4,500
Danielson	Danielson Engine Works, Chicago, Ill		1½,28, $2,000				5, 45, $4,500	
Dart	Dart Manufacturing Co , Waterloo, Ia	½, 20, $715	1, 30, $1,300	2, 40, $1,775				
Dayton	Dayton Automobile Truck Co , Dayton, O.		1, 25, $1,500	2, 30, $2,650	3, 30, $3,400	4, 40, $3,900	5, 40, $4,500	7, 64, $5,900
Day Utility	Day Automobile Co., Detroit, Mich	—, 33, $1,500	(Combinatio	n body)				
Dispatch	Dispatch Motor Car Co., Minneapolis, Minn.	½, 23, $800						
Dorris	Dorris Motor Car Co., St Louis, Mo	¾, 45, $2,100		2, 45, $2,500	3, 45,			
Duplex	Duplex Power Car Co , Charlotte, Mich			2, 26, $2,400				
Duryea	Duryea Motor Co , Saginaw, Mich.	½, 23 $600.						
Evans	Evans Limited Commercial Car Co., Nashville, Tenn		1, 30, $1,000					
Federal	Federal Motor Truck Co., Detroit, Mich.		1½,30, $1,800					
Flint	Durant-Dort Carriage Co , Flint, Mich.	¾, 22, $1,375						
Four Wheel Drive	Four Wheel Drive Automobile Co , Clintonville, Wis.		1½,29, $3,600		3, 36, $4,000			
Gabriel	Gabriel Automobile Co , Cleveland, O.	½, 22, $900.	1, 35, $2,000					
Garford	The Garford Co., Elyria, O.			2, 29, $2,800	3, 29, $3,500		5, 29, $4,500	
Gay	S G Gay Co., Ottawa, Ill	¾, 25, $1,500	1, 25, $1,500					
G. M C.	General Motors Truck Co., Pontiac, Mich		1½ 20, $1,900	2, 25, $2,600	3½,40, $3,500		5, 40, $4,500	
Gramm	Gramm-Bernstein Co., Lima, O		1, 30, $1,750	2, 45, $2,750	3½,45, $3,600		5, 60, $4,500	
Harvey	Harvey Motor Truck Works, Harvey, Ill		1½,23, $1,875					
Hatfield	Hatfield Automobile Truck Co , Elmira, N Y	½, 18, $850	1, 20, $1,200					
Hewitt-Ludlow	Hewitt-Ludlow Automobile Co., San Francisco, Cal.		1½,30, $2,250					
Horner	Detroit-Wyandotte Motor Co , Wyandotte, Mich	2/5, 17, $975	1, 24, $2,000	2, 27, $2,650	3, 32, $3,200		5, 44, $4,200	
Hupmobile	Hupp Motor Car Co , Detroit, Mich							
Ideal	Ideal Automobile Co , Fort Wayne, Ind		1, 30, $1,500	2½,45, $2,500				
International	International Harvester Co , Chicago, Ill	½, 20 (Prices	on applicatio	n)				
Juno	Juno Motor Truck Co , Juneau, Wis			2, 35, $2,800	3, 45, $3,400			
Jeffery	Thomas B. Jeffery Co , Kenosha, Wis	¾, 38, $1,250	1, 38, $1,500					
Kalamazoo	Kalamazoo Motor Vehicle Co , Kalamazoo, Mich.		1½,30, $1,700					
Kearns	Kearns Motor Truck Co , Beavertown, Pa	¾, 23, $850						
Kelly	Kelly-Springfield Motor Truck Co , Springfield, O		1½,25, $2,000		3, 39, $3,400	4, 39, $3,500		
King	A R King Manufacturing Co , Kingston, N Y				3½,45, $3,350			
Kissel Kar	Kissel Motor Car Co , Hartford, Wis.	¾, 36, $1,500	1, 38, $1,650	2½,38, 2,750	3½, . . . 3,350			6, . . . $4,500
Knox	Knox Automobile Co., Springfield, Mass			2, 40, $3,000				6, 40, $5,200
Koehler	H J Koehler S. G. Co , New York city		1, 24, $725					
Kosmoth	The Kosmoth Co., Detroit, Mich.	½, 20, $630						
Krebs	Krebs Commercial Car Co , Clyde, O		1½,23, $1,775					
Krit	Krit Motor Car Co., Detroit, Mich.	½, 28, $900						
Landshaft	William Landshaft & Son, Chicago, Ill	¾, 20, $1,000	1, 28, $1,450	2, 35, $2,250	3, 45, $2,750		5, 45, $3,250	
Lange	Lange Motor Truck Co , Pittsburgh, Pa		1, 30, $2,250	2, 35, $3,000				
Lauth-Juergens	Lauth-Juergens Motor Car Co , Fremont, O		1, 30, $2,100	2, 30, $2,800	3, 40, $3,450		5, 50, $4,500	
Lewis	Lewis Motor Truck Co., San Francisco, Cal.			2½,40, $3,250	3, 40, $3,500		5, 50, $4,750	
Lippard-Stewart	Lippard-Stewart Motor Car Co , Buffalo, N. Y.	¾, 30, $1,650	1½,35, $2,300					
Luck Truck	Cleburne Motor Car Co., Cleburne, Texas	½, 25, $800						
Light	Light Commercial Car Co., New York City	½, 10, $475						
Little Giant	Chicago Pneumatic Tool Co , Chicago, Ill.		1, 25, $1,350					
Locomobile	Locomobile Company of America, Bridgeport, Conn						5, 40, $4,500	
Longest	Longest Bros. Co., Louisville, Ky.				3, 40, $4,000		5, 40, $4,500	
Mack	International Motor Co., New York City		1, 32, $2,000	2, 32, $2,700	3, 48, $3,400		5, 48, $4,000	7½,48, $5,000
Mais	Mais Motor Truck Co., Indianapolis, Ind		1½,—, $2,750	2½,—, $3,200	3, —, $3,400			
Mansur	Mansur Motor Truck Co., Haverhill, Mass.		1½,30, $2,400					
Marmon	Nordyke & Marmon Co., Indianapolis, Ind	¾, 30, $2,500						
Martin	Martin Carriage Works, York, Pa.		1½,35,	2, 40,		4, 55 (Prices	on applicatio	n)
Mason	Mason Motor Co., Waterloo, Ia.	¾, 28, $800						
McIntyre	W. H McIntyre Co., Auburn, Ind.	½, . . . $800	1½, . . . $2,300		3, . . . $3,200			
Menominee	D F Poyer Co , Menominee, Mich.	¾, 25, $1,125	1½,35, $1,800					
Messinger	Messinger Manufacturing Co , Tatamy, Pa.			2, 30, $2,400				
Miller	Miller Car Co , Detroit, Mich.	½, 22, $850						
Modern	Bowling Green Motor Car Co , Bowling Green, O.	¾, 25, $1,500	1, 30, $1,700					
Moeller	New Haven Truck and Automobile Works, New Haven, Conn		1½,30, $2,500		3, 35, $3,400		5, 45, $4,500	
Mogul	Mogul Motor Truck Co , St. Louis, Mo.			2, 35, $2,360			5, 50, $4,300	6, 60, $4,800
Moon	Jas W. Moon Buggy Co., St Louis, Mo.	½, 28, $1,350	1½,30, $1,800					
Moore	Pacific Metal Products Co., Torrence, Cal.		1½,35, $1,975	2, 45, $2,500	3, 45, $3,150	4, 55, $3,800	5, 55, $4,500	6, 65, $4,900
Mora	Mora Power Wagon Co., Cleveland, O.		1, 25, $1,400					
Moreland	Moreland Motor Truck Co , Los Angeles, Cal	¾, 30, $1,700	1½,32, $1,960	2, 40, $2,350	3, 58, $3,150	4, 65, $3,500	5, 80, $4,500	
Natco	National Motor Truck Co., Bay City, Mich.		1, 20, $1,925					
Nelson	Nelson & LeMoon, Chicago, Ill.		1, 30, $1,800	2, 35, $2,250	3, 40, $2,750			
New York	Tegetmeier & Riepe Co , New York City		1½,30, $2,100					
Neustadt	E L Epperson Commercial Truck Co., St. Louis, Mo.		1, 26, $1,000	2, 35, $1,250				
Old Reliable	Old Reliable Motor Truck Co , Chicago, Ill			2, 35, $2,750		4, 45, $4,000	5, 45, $4,500	
Packard	Packard Motor Car Co , Detroit, Mich.			2, 28, $2,900	3, 32, $3,500	4, 32, $3,550	5, 40, $4,000	6, 40, $4,650
Palmer	Palmer-Meyer Motor Car Co., St Louis, Mo		1, 30, $1,600	2, 35, $2,000				
Palmer-Moore	Palmer-Moore Co , Syracuse, N. Y.		1, 20, $1,350					
Perfex	The Perfex Co , Los Angeles, Cal	½, 16, $900						
Peerless	Peerless Motor Car Co , Cleveland, O.				3, 32, $3,700	4, 32, $4,000	5, 32, $4,500	6, 32,
Pierce-Arrow	Pierce-Arrow Motor Car Co , Buffalo, N Y			2, 36, $3,000			5, 38, $4,500	
Pope-Hartford	Pope Manufacturing Company, Hartford, Conn.				3, 50, $3,350		5 50, $4,350	
Progress	Universal Machine Co , Milwaukee, Wis		1½,32, $2,250		3, 45, $3,500			
Republic	Alma Motor Truck Co , Alma, Mich.		1, 30, $1,350					
Robinson	Robinson Motor Truck Co , Minneapolis, Minn		1½,30, $2,200	2, 35, $2,500	3, 40, $3,200	4, 45, $3,500	5, 50, $3,900	
Rockford	Rockford Motor Truck Co , Rockford, Ill	¾, 25, $1,500		2, 35, $2,800				
S & S	Sayers & Scovill Co , Cincinnati O.		35, $1,850 (A	mbulance and	Hearse bodie	s)		
Sandusky	Sandusky Automobile Parts and Motor Truck Co., Sandusky, O.	¾, 25, $1,400	1½,25, $1,900					
Sanford	Sanford Motor Truck Co , Syracuse, N. Y		1, 26, $1,660					
Saurer	International Motor Co , New York City.						5, 31, $4,800	6½,31, $5,200
Service	Service Motor Car Co , Wabash, Ind		1½,40, $1,800	2, 40, $2,375	3, 45, $2,975			
Schacht	G A Schacht Motor Truck Co , Cincinnati, O			2, 29, $2,550				
Smith	A O Smith Co , Milwaukee Wis				3½,40, $3,750			6, 50, $4,750
Speedwell	Speedwell Motor Car Co , Dayton, O			2, 27, $2,850		4, 40, $3,750		[illegible]
Standard	Standard Motor Truck Co , Detroit, Mich				3, 32, $3,350			
Star	Star Motor Car Co , Ann Arbor Mich.	¾, 30, $1,500	1½,35, $1,800					
Stearns	F B Stearns Co , Cleveland, O						5, 36, [illegible]	
Stegeman	Stegeman Motor Car Co , Milwaukee, Wis	¾, 30, $1,600	1, 30, $2,250	2, 35, $2,950	3, 45, $3,500	4, 45, $3,950		
Sternberg	Sternberg Manufacturing Co., Milwaukee, Wis.			2, 30, $2,800	3, 20, $3,400	4, 32, $4,000	5, 32, [illegible]	[illegible]
Stewart	Stewart Motor Corporation, Buffalo, N Y	¾, 30, $1,500						
Stewart	Stewart Iron Works, Cincinnati, O		1, 20, $1,150					
Studebaker	Studebaker Corporation of America, Detroit, Mich	¾, 35, $1,050						
Sullivan	Sullivan Motor Car Co , Rochester, N. Y.	½, 18, $925	1, 18, $1,050					
Tiffin	Tiffin Wagon Co , Tiffin, O	3/5, 25, $1,600	1, 30, $2,000	2, 35, $2,600				
Transit	Transit Motor Truck Co , Louisville, Ky		1, 23, $2,000	2, 27, $2,850	3½, [illegible]		5, 32, [illegible]	

A Quick Reference Table for Commercial Motor Vehicle Buyers—Concluded

Name of Vehicle.	Name and Address of Manufacturer.	Tons Capacity, Horse-power and Price.						
		Under 1 ton.	1-1½.	2-2½.	3-3½.	4.	5.	6 and over
Trojan	Toledo Carriage Co., Toledo, O.	½, —, $1,500						
Tulsa	Tulsa Automobile Manufacturing Co., Tulsa, Okla.	¾, 42, $1,250						
U. S.	United States Motor Truck Co., Cincinnati, O.			2, 27, $2,800	3, 32, $3,500			
Universal	Universal Motor Truck Co., Detroit, Mich.		1½, 23, $1,950		3, 25, $3,400			
Van Winkle	Van Winkle Motor Truck Co., Atlanta, Ga.		1½, 30, $2,250	2½, 30, $2,800	3½, 45, $3,500			
Veerac	Veerac Motor Co., Anoka, Minn.	¾, 20, $925.						
Velie	Velie Motor Vehicle Co., Moline, Ill.	¾, 32, $1,600		2, 32, $2,850	3, 32, $3,350			
Vulcan	Driggs-Seabury Ord. Corp., Sharon, Pa			2, 26, $2,750	3, 26, $3,250	4, 30, $4,000	5, 30, $4,500	7, 36, $6,000
Wade	Wade Commercial Car Co., Holly, Mich.	2/5, 8, $375.						
Wagenhals	Wagenhals Motor Co., Detroit, Mich.	2/5, 20, $690.						
Ware	Ware Motor Vehicle Co., St. Paul, Minn.			2, 40, $3,000	(4 wheel driv	e)		
Wichita	Wichita Falls Motor Co., Wichita Falls, Texas		1, 30, $1,650	2, 35, $2,100	3½, 50, $3,250			
White	The White Co., Cleveland, O.	¾, 28, $2,100	1½, 28, $3,000		3, 23, $3,700		5, 28, $4,500	
White Star	White Star Motor Co., Brooklyn, N. Y.		1, 30, $2,000	2, 35, $2,750	3, 40, $3,400	4, 45, $3,700	5, 45, $4,200	
Wilcox	H. E. Wilcox Motor Car Co., Minneapolis, Minn.		1, 27	2, 29	3, 29	(Prices on ap	plication)	
Wilt	Wilt Engine and Truck Co., Buffalo, N. Y.	¾, 23, $1,650		2, 32, $3,800				
Willys-Utility	Gramm Motor Truck Co., Lima, O.	¾, 27, $1,250						
Wit-Will	Wit-Will Co., Washington, D. C.		1, 35	2, 42		4, 50	(Prices on ap	plication)

Since the majority of the gasoline commercial vehicles have 4-cylinder motors, this figure has been omitted from the above table. The first figure in each case represents the tons capacity, the second figure the horse-power, and the third the price. Only the most representative models of each manufacturer are listed. The prices for the most part for the chassis only. Bodies are usually made to order.

Electric Commercial Vehicles

As in the Gasoline Commercial Vehicle list, the prices are almost invariably for the chassis only. Bodies are built to order.

Name of Vehicle.	Name and Address of Manufacturer	Tons Capacity, Horse-power and Price						
		Under 1 Ton.	1-1½	2-2½.	3-3½	4	5	6 and over.
Argo	Argo Electric Vehicle Co., Saginaw, Mich	½, $1,000	1, $2,150					
Atlantic	Atlantic Vehicle Co., New York City	½, $1,960	1, $2,200.	2, $2,750.	3½, $3,375.		5, $3,825	
Baker	Baker Motor Vehicle Co., Cleveland, O.	½, $1,900.	1, $2,300.	2, $2,800	3½, $3,500			
Borland	Borland-Grannis Co., Chicago, Ill.	¾, $2,100						
Buffalo	Buffalo Electric Vehicle Co., Buffalo, N. Y.		1, $2,400					
Capitol	Capitol Truck Manufacturing Co., Denver, Colo.	½, $1,800						
Couple Gear	Couple Gear Freight Wheel Co., Grand Rapids, Mich				3, $3,650		5, $4,150 (Front	wheel drive)
Couple Gear	Couple Gear Freight Wheel Co., Grand Rapids, Mich				3½, $4,400		5, $5,000 (Four	wheel drive)
C. T.	Commercial Truck Company of America, Philadelphia, Pa.	½, $1,040	1, $2,345	2, $3,050	3½, $3,880		5, $4,310	
Dayton	Dayton Electric Car Co., Dayton, O	½, $1,400.						
Detroit	Anderson Electric Car Co., Detroit, Mich	½, $2,350	1, $2,800	2, $3,750	3, $5,000		5, $5,500	
Eldridge	Eldridge Manufacturing Co., Boston, Mass			2,	3,		5,	7, 10, *
G. M. C.	General Motors Truck Co., Pontiac, Mich	½, $1,400.	1, $1,500	2, $2,000	3, $2,300	4, $2,650	5, $2,950	6, $3,200
G. V. Electric	General Vehicle Co., Long Island City	½, $1,700	1, $2,100	2, $2,600	3½, $3,250		5, $3,700	
Urban	Kentucky Wagon Manufacturing Co., Louisville, Ky.	½,	1,	2,	3½.	(Prices on appli	cation)	
Victor	M. & P. Electric Vehicle Co., Detroit, Mich.	½, $1,550	1, $2,100.					
Walker	Walker Vehicle Co., Chicago, Ill.	½.	1, 1½.	2½.	3½.	(Prices on appli	cation)	
Ward	Ward Motor Vehicle Co., New York City	¾, $1,450	1½, $1,900	2½, $2,400			5 $2,950	
Waverley	The Waverley Co., Indianapolis, Ind.	½, $2,000	1, $2,400	2, $3,250	3½, $3,750		5, $4,500	

* Front wheel drive.

Scarcity of True Box Wood

IN the literature of the commercial woods of the world the word "box" appears frequently, applied oftentimes to woods that are widely distinct from each other. The word is usually employed with a prefix, even when the true box wood is meant, as Persian box, Russian box, Himalayan box, etc. In this article will be considered the wood of the box tree proper, the *Buxus sempervirens* of the botanists, which has been so generally imported into the United States and England as wood for the engraver's use. The German name of this tree is buxbaum; in French it is called buis; the Italian name is bosso, from which doubtless, its Latin name, *Buxus*, is derived; and in Persia it is known as Shanda laghune.

Its native home is Persia and the territory surrounding the Black and Caspian Seas, but it is in general cultivation in many parts of the world, and grows successfully as far north as 52 degrees latitude. While it grows in the temperate and more tropical climates, it is only for export in southern Europe and in parts of southern Asia. It is at present derived mainly from the forests of the Caucasus, Armenia, and the Caspian shores. The wood of the best qualities comes from the Baltic Sea forests and is shipped largely from the port of Poti. It is grown also in all parts of India, and in many districts flourishes in a wild state. It is but little planted and protected for its wood, but is largely grown and highly esteemed in Europe for ornamental and other useful purposes. To the gardener the box is a well-known, hardy evergreen tree or shrub, which seldom exceeds the height of from 12 to 15 feet in the United States, but in Turkey and Asia Minor it is sometimes found as high as 25 feet. The thickness of the trunk is often out of proportion to the height of the tree, because in full grown trees it varies from 6 to 9 inches in diameter near the ground.

Box wood is remarkably heavy (about 70 pounds per cubic foot), very hard, fine and straight-grained, takes a very high polish, and has a light yellow color. It is very liable to check in drying, and in order to prevent this the wood is placed in a dark cellar for from three to five years. At the end of this time the sapwood is removed with a hatchet and the heartwood again placed in a dark cool cellar or barn until wanted. For the best result the wood should be boiled for some time, and after it is dry, buried in dry sand until required.

The box wood has been in great demand already by the Greeks and Romans, and Theophrastus classed it with that of ebony on account of its usefulness and very fine grain. Pliny described box wood and said that it is as hard to burn as iron, and observed that it is totally unfit for charcoal. Both Virgil and Ovid stated that the wood was used very early for making musical instruments. With the advance of civilization box wood came into use for wood carving, and for this purpose it soon formed an important article of trade. It was also used extensively in England very early in cabinet making and inlaying, turnery, and a multitude of other purposes.

The use of box wood has been so very great that it is becoming scarce and consequently very costly. It is now so valuable that the trees are dug up by their roots and the latter are used for various articles of turnery. The root wood is very beautifully marbled or veined and the articles manufactured from it vary in value accordingly. The tree grows exceedingly slow, and the rate of consumption is far greater than the growth. No wood has yet been found to take the place of box for engraving, and for this the demand is great and the supply is limited. The want of the present day is a suitable substitute.

Mechanical Management

SO much has been said of late about scientific management in manufacturing establishments that it may be desirable to look ahead a little and endeavor to see just what departments of productive activity are really in line to be managed according to the methods thus advocated. In general, it seems as if the lines of work capable of such organization and conduct are those from which, in the course of a comparatively short time, the skilled mechanic may be almost wholly eliminated.

Repetitive processes, operations which may be described in instruction cards or planned out wholly in advance by some one other than the individual by whom they are to be executed, are the very ones from which the element of individual judgment may be almost entirely removed, and therefore are next in line to be turned over to an inanimate and almost entirely automatic machine. The things which the machine cannot do to advantage are those which are not performed twice alike, and into which the immediate and varying judgment of the man who is really doing the work must enter. Such work is becoming of less and less importance from the commercial point of view, and the real mechanic, according to the old-time standard, is almost to be classed with the artist, the man into whose work his own personality enters so largely as to make it impracticable for him to tell any one else how to do it as well.

When a piece of work demands the private judgment of the operator to any material extent, it is hardly adaptable to any system of intensified production, such as is desirable for the methods of modern scientific management.

It follows that one of the important things in connection with the introduction of such a plan lies in the systematization of the product itself, to render its manufacture practicable under the new conditions. If, however, such a study is given to the repetitive character of the product, it will be found, in nearly every instance, to lead to the introduction of such mechanical methods as to take practically all discretion out of the hands of the operative and convert him into a machine tender, his speed being determined by that of the machinery with which he is associated, and he himself becoming practically a part of those machines.

Such a condition of affairs has already been reached in some departments of industry, and there is every reason to believe that it will be extended. Its growth means a change in industrial conditions which will well bear examining, and it seems as if the present interest in scientific management is really only an intermediate and passing stage in a far deeper transformation in manufacturing conditions.

The kind of work which, if done by men, must be done in a mechanical manner, is the kind of work which should not be done by men at all; and it is for the advancement of the race to have it taken out of the hands of human beings and transferred to inanimate mechanism. This means that men must be given a higher and better kind of work to do, work which involves the use of their heads as well as their hands, and the men who have hitherto performed purely mechanical work qualify for the newer and higher class of activity. The Suez Canal was dug with human hands and wicker baskets; the Panama Canal is being excavated by the steam shovel, the hydraulic jet, and the dump car, under the guidance of men of intelligence and judgment.

When, therefore, any department of industry is studied with a view to the introduction of scientific management, it is suggested that the study be carried on to the next stage of technical progress without lingering at the transitory phase, and that a direct effort be made to arrange the product and the processes in such a manner as to permit the employment of a limited number of highly intelligent directors, and of such a number of machine tenders as may be necessary, relegating everything which can possibly be performed in a purely mechanical manner to a machine and not to a man.—*Cassier's Magazine.*

Preventing Mold on Books.—An effective way to prevent books from becoming musty and possibly moldy in moist weather is to place a few drops of oil of lavender and Canadian balsam in a back corner of each shelf. This will not injure the bindings of leather books as sulphur compounds do, but helps preserve the bindings. The two substances are easily obtained.

A Price List and Table of 1914 American Gasoline Pleasure Cars

A Ready Reference Table for the Prospective Automobile Purchaser

Compiled by C. Edward Palmer

THE composite price list of pleasure cars published in the Scientific American *Automobile Number of 1913 received such favorable comment at the time that it has been decided this year to publish a list on a much broader scale. Such lists are of great benefit to those who visit motor shows with the intention of buying a car. Every prospective automobile buyer must answer the old question: "What Cars Are Within My Price?" It is chiefly for the benefit of such prospective buyers that the compact information here presented has been prepared.*

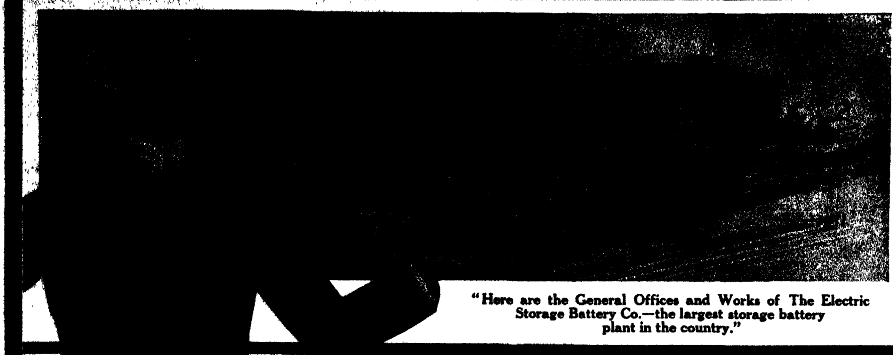
The following table is self-explanatory except for the abbreviations used. In the fourth column the first figure indicates the number of cylinders; the second gives the rated horse-power. The letters refer to the type of body used on that particular chassis. Thus, r, *means roadster;* t, *means touring car;* l, *limousine;* c, *coupé;* ld, *landaulet;* p, *phaeton;* b, *berline;* s, *sedan.*

The table does not pretend to be absolutely complete. It does not include manufacturers whose output amounts only to a very few number of cars each year; nor does it include every car turned out by the manufacturers listed. Wherever further information as to other types is desired the manufacturers will furnish complete details, catalogues, and specifications on request.

Price.	Name of Car	Name and Address of Manufacturer	No. of Cylinders, Horse-power and Body Type
$450	Duryea	Duryea Motor Co., Saginaw, Mich	2, 14 buggy
475	Metz	Metz Co., Waltham, Mass	4, 22, r
495	Grant	Grant Motor Co., Detroit, Mich	4, 21, r
500	Ford	Ford Motor Co., Detroit, Mich	4, 20, r
550	Ford	Ford Motor Co., Detroit, Mich	4, 20, t
650	Duryea	Duryea Motor Co., Saginaw, Mich	2, 14, r
750	Chevrolet	Chevrolet Motor Co., Flint, Mich	4, 24, r
750	Comet	Continental Motors Corpn., Buffalo, N. Y	4, 25, r
750	Ford	Ford Motor Co., Detroit, Mich	4, 20, c
750	Maxwell	Maxwell M. C. C., Detroit, Mich	4, 25, t
750	Oriole	Columbia Electric Co., Knightstown, Ind	4, 20, r
750	Vulcan	Vulcan Mfg. Co., Painesville, O	4, 27, r
850	Detroiter	Briggs-Detroiter Co., Detroit, Mich	4, 25, t
850	Read	Read M. C. Co., Detroit, Mich	4, 33, t
850	Vulcan	Vulcan Mfg. Co., Painesville, O	4, 27, t
875	Chevrolet	Chevrolet Motor Co., Flint, Mich	4, 24, t
885	Studebaker	Studebaker Corp. of America, Detroit, Mich	4, 25, t
900	Detroiter	Briggs-Detroiter Co., Detroit, Mich	4, 25, r. t
900	Dispatch	Dispatch M. C. Co., Minneapolis, Minn	4, 30, t
900	Empire	Empire Auto. Co., Indianapolis, Ind	4, 23, t
900	Krit	Krit M. C. Co., Detroit, Mich.	4, 28, r
900	Perfex	The Perfex Co., Los Angeles, Cal	4, 16, t
900	R. C. H	R. C. H. Corp., Detroit, Mich	4, 17, r. t
950	Buick	Buick Motor Co., Flint, Mich	4, 24, r
950	Krit	Krit M. C. Co., Detroit, Mich	4, 28, t
950	Overland	Willys-Overland Co., Toledo, O.	4, 27, r. t
950	Lambert	Buckeye Manufacturing Co., Anderson, Ind	4, 25, r
975	Comet	Continental Motors Corp., Buffalo, N. Y	4, 25, t
975	Marathon	Herff-Brooks Corp., Indianapolis, Ind	4, 20, t
975	Partin-Palmer	Partin Mfg. Co., Chicago, Ill.	4, 38, t
985	Continental	Martindale & Millikan	4, 20, t.
1,000	Dispatch	Dispatch M. C. Co., Minneapolis, Minn	4, 30, c
1,025	Paige	Paige-Detroit M. C. Co., Detroit, Mich	4, 25, t
1,050	Buick	Buick Motor Co., Flint, Mich	4, 25, t
1,050	Monarch	Monarch M. C. Co., Detroit, Mich	4, 25, t
1,050	Hupmobile	Hupp M. C. Co., Detroit, Mich	4, 32, r. t
1,075	Lambert	Buckeye Mfg. Co., Anderson, Ind	4, 25, r
1,125	Regal	Regal M. C. Co., Detroit, Mich	4, 25, r. t
1,150	Crow-Elkhart	Crow M. C. Co., Elkhart, Ind.	4, 35, t
1,150	Oakland	Oakland M. C. Co., Pontiac, Mich	4, 36, r
1,175	Reo	Reo M. C. Co., Lansing, Mich	4, 30, r. t
1,195	King	King M. C. Co., Detroit, Mich	4, 30, r. t
1,200	Hupmobile	Hupp M. C. Co., Detroit, Mich	4, 32, t
1,200	Oakland	Oakland M. C. Co., Pontiac, Mich	4, 36, t
1,200	Cameron	Cameron Mfg. Co., New Haven, Conn	4, 30, r. t. c. s
1,200	Lambert	Buckeye Mfg. Co., Anderson, Ind	4, 30, t
1,235	Paterson	W. A. Paterson Co., Flint, Mich.	4, 33, t
1,250	Case	J. I. Case T. M. Co., Racine, Wis	4, 25, t
1,250	Cartercar	Cartercar Co., Pontiac, Mich	4, 30, r. t
1,250	Herreshoff	Herreshoff Motor Co., Detroit, Mich	4, 30, r
1,250	Light	Light M. C. Co., Detroit, Mich	6, 30, t
1,250	Richmond	Wayne Works, Richmond, Ind	4, 27, r. t.
1,275	Ohio	Crescent Motor Co., Cincinnati, O	4, 35, t
1,275	Paige	Paige-Detroit M. C. Co., Detroit, Mich	4, 36, r. t
1,280	Lexington	Lexington M. C. Co., Connersville, Ind	4, 40, t
1,290	Traveler	Traveler M. C. Co., Detroit, Mich	4, 28, t
1,290	Studebaker	Studebaker Corp. of America, Detroit, Mich	4, 35, t
1,300	R. C. H.	R. C. H. Corp., Detroit, Mich	4, 17, c
1,325	Marathon	Herff-Brooks Corp., Indianapolis, Ind	4, 30, t
1,335	Davis	George W. Davis M. C. Co., Richmond, Ind	4, 35, r. t
1,350	Metropol	Metropol Motors Co., New York City	4, 30, r.
1,350	Regal	Regal M. C. Co., Detroit, Mich	4, 35, t
1,350	Herreshoff	Herreshoff Motor Co., Detroit, Mich	4, 30, t
1,350	Hupmobile	Hupp M. C. Co., Detroit, Mich	4, 32, c
1,365	Lambert	Buckeye Mfg. Co., Anderson, Ind	4, 35, r
1,385	Jackson	Jackson Auto. Co., Jackson, Mich	4, 40, t.
1,395	Allen	Allen M. C. Co., Fostoria, O	4, 28, r. t.
1,395	Lambert	Buckeye Mfg. Co., Anderson, Ind	4, 40, t
1,475	Chevrolet	Chevrolet Motor Co., Flint, Mich.	6, 35, t.
1,490	Auburn	Auburn Auto. Co., Auburn, Ind	4, 40, t
1,495	Marathon	Herff-Brooks Corp., Indianapolis, Ind	4, 32, t
1,500	Imperial	Imperial Auto. Co., Jackson, Mich	4, 28, r. t
1,500	Halladay	A. C. Barley, Streator, Ill	4, 38, t
1,500	Velie	Velie M. Vehicle Co., Moline, Ill	4, 35, t
1,500	Alter-Car	Cincinnati M. Mfg. Co., Cincinnati, O	4, 33, t.
1,500	Day Utility	Day Auto. Co., Detroit, Mich.	4, 33, t
1,500	Jeffery	Thos. B. Jeffery Co., Kenosha, Wis	4, 33, r. t.
1,500	Overland	Willys-Overland Co., Toledo, O	4, 27, c
1,500	Richmond	Wayne Works, Richmond, Ind	6, 38, t.
1,550	American	American Motors Co., Indianapolis, Ind	4, 26, r.
1,550	Studebaker	Studebaker Corp. of America, Detroit, Mich	6, 30, t
1,585	Henderson	Henderson M. C. Co., Indianapolis, Ind	4, 44, t
1,595	Mitchell	Mitchell-Lewis M. Co., Racine, Wis	4, 40, r. t.
1,600	Apperson	Apperson Bros. Auto. Co., Kokomo, Ind.	4, 45, r. t
1,600	Fal-Car	Fal Auto. Co., Chicago, Ill	4, 40, r. t.
1,600	Regal	Regal M. C. Co., Detroit, Mich.	4, 25, c.
1,635	McIntyre	W. H. McIntyre Co., Auburn, Ind	6, 40, t.
1,650	Marion	Marion M. C. Co., Indianapolis, Ind	4, 26, r. t
1,685	Kline Kar	Kline M. C. Corp., Richmond, Va	4, 30, r. t.
1,700	Cartercar	Cartercar Co., Pontiac, Mich	4, 30, t
1,710	Great Western	Great Western Auto. Co., Peru, Ind	4, 40, r. t.
1,745	Ames	Ames M. C. Co., Owensboro, Ky	4, 28, r.
1,750	Crow-Elkhart	Crow M. C. Co., Elkhart, Ind	4, 40, t
1,750	Paterson	W. A. Paterson Co., Flint, Mich	4, 41, t.
1,750	Moon	Moon M. C. Co., St. Louis, Mo.	4, 42, r. t
1,750	Crawford	Crawford Auto. Co., Haggerstown, Md	4, 37, t.
1,775	Chalmers	Chalmers Motor Co., Detroit, Mich.	4, 36, t.
1,775	Pullman	Pullman M. C. Co., York, Pa	4, 30, t
1,785	Apperson	Apperson Bros. Auto. Co., Kokomo, Ind	4, 45, t
1,785	Abbott-Detroit	Abbott Motor Co., Detroit, Mich.	4, 34, r. t.
1,785	Chandler	Chandler M. C. Co., Cleveland, O	6, 35, t.
1,785	Henderson	Henderson M. C. Co., Indianapolis, Ind	4, 46, r. t.
1,785	Oakland	Oakland M. C. Co., Pontiac, Mich	4, 48, t.
1,785	Oakland	Oakland M. C. Co., Pontiac, Mich	6, 48, t.
1,785	Ames	Ames M. C. Co., Owensboro, Ky	4, 28, t
1,800	Buick	Buick Motor Co., Flint, Mich	4, 38, c.
1,800	Corbitt	Corbitt Auto. Co., Henderson, N. C	4, 33, r.
1,800	South Bend	South Bend M. C. Wks., South Bend, Ind	4, 50, r.
1,825	ArBenz	ArBenz Car Co., Chillicothe, O	4, 45, r
1,850	Firestone-Columbus	Columbus Buggy Co., Columbus, O	4, 30, r. t.
1,850	Paige	Paige-Detroit M. C. Co., Detroit, Mich	4, 36, c.
1,850	Case	J. I. Case, T. M. Co., Racine, Wis	4, 35, t
1,850	Herreshoff	Herreshoff Motor Co., Detroit, Mich	6, 45, r. t.
1,850	Schacht	Schacht M. C. Co., Cincinnati, O	4, 29, t
1,875	Spaulding	Spaulding Mfg. Co., Grinnell, Ia	4, 40, t
1,875	Rambler	Thos. B. Jeffery Co., Kenosha, Wis	4, 32, t
1,885	Staver	Staver Carriage Co., Chicago, Ill	4, 55, t.
1,885	ArBenz	ArBenz Car Co., Chillicothe, O	4, 45, t.
1,885	Jackson	Jackson Auto. Co., Jackson, Mich	4, 45, t
1,895	Mitchell	Mitchell-Lewis M. Co., Racine, Wis.	6, 50, r. t
1,900	Cartercar,	Cartercar Co., Pontiac, Mich.	4, 36, c
1,925	Cole	Cole M. C. Co., Indianapolis, Ind.	4, 29, r. t.
1,950	Moline	Moline Auto. Co., East Moline, Ill	4, 40, t.
1,950	Pacific Special	Cole California Car Co., Oakland, Cal	4, 33, r. t.
1,975	Cadillac	Cadillac M. C. Co., Detroit, Mich	4, 50, r. t. p.
$1,975	Pullman	Pullman M. C. Co., York, Pa.	4, 44, t.
1,975	Corbitt	Corbitt Auto. Co., Henderson, N. C.	4, 33, t.
1,975	Maxwell	Maxwell Motor Co., Detroit, Mich.	6, 50, t.
1,985	Buick	Buick Motor Co., Flint, Mich	4, 55, t
1,985	Havers	Havers M. C. Co., Port Huron, Mich	6, 44, r. t.
1,985	Kline Kar	Kline M. C. Corp., Richmond, Va	4, 40, r. t.
1,985	Ohio	Crescent Motor Co., Cincinnati, O.	6, 60, t.
1,985	Haynes	Haynes Auto. Co., Kokomo, Ind	4, 29, r. t
1,985	Davis	George W. Davis M. C. Co., Richmond, Ind.	4, 50, t.
2,000	Velie	Velie M. Vehicle Co., Moline, Ill	4, 45, r. t.
2,000	Coey "Flyer"	Coey-Mitchell Auto Co., Chicago, Ill	6, 50, r. t.
2,000	Stutz	Stutz M. C. Co., Indianapolis, Ind	4, 65, r.
2,000	Traveler	Traveler M. C. Co., Detroit, Mich	6, 48, t.
2,000	Imperial	Imperial Auto. Co., Jackson, Mich	6, 34, t.
2,000	Lenox	Lenox M. C. Co., Hyde Park, Mass	4, 40, r. t.
2,000	Auburn	Auburn Auto. Co., Auburn, Ind	6, 45, t.
2,050	Studebaker	Studebaker Corp. of America, Detroit, Mich	4, 35, c.
2,085	Abbott-Detroit	Abbott Motor Co., Detroit, Mich.	4, 44, t.
2,100	Crawford	Crawford Auto. Co., Haggerstown, Md.	4, 48, t
2,100	Lozier	Lozier Motor Co., Detroit, Mich	4, —, t.
2,125	Firestone-Columbus	Columbus Buggy Co., Columbus, O.	4, 40, t.
2,150	Marion	Marion M. C. Co., Indianapolis, Ind	4, 26, c.
2,150	Marion	Marion M. C. Co., Indianapolis, Ind	6, 34, r. t
2,150	Pratt	Elkhart C. & H. Mfg. Co., Elkhart, Ind	4, 50, t
2,150	Moon	Moon M. C. Co., St. Louis, Mo.	6, 58, r. t
2,150	Jackson	Jackson Auto. Co., Jackson, Mich	6, 55, t.
2,150	Davis	George W. Davis M. C. Co., Richmond, Ind	6, 50, t
2,160	Pathfinder	Motor Car Mfg. Co., Indianapolis, Ind	4, 40, r.
2,175	Chalmers	Chalmers Motor Co., Detroit, Mich.	6, 40, r. t
2,185	De Soto	De Soto M. C. Co., Auburn, Ind	6, 38, t
2,185	Zimmerman	Zimmerman Mfg. Co., Auburn, Ind	6, 38, t.
2,185	Pathfinder	Motor Car Mfg. Co., Indianapolis, Ind	4, 40, t
2,200	Apperson	Apperson Bros. Auto. Co., Kokomo, Ind	6, 45, r. t.
2,225	Moon	Moon M. C. Co., St. Louis, Mo	6, 58, t.
2,250	Pilot	Pilot Motor Sales Co., Richmond, Ind.	4, 50, r. t
2 250	Pope	Pope Mfg. Co., Hartford, Conn.	4, 31, r. t. p.
2,250	Hudson	Hudson M. C. Co., Detroit, Mich.	6, 55, p.
2,250	Crow-Elkhart	Crow M. C. Co., Elkhart, Ind.	6, 50, t.
2,250	Great Southern	Great So. Auto. Co., Birmingham, Ala	4, 60, t
2,250	Pope-Hartford	Pope Manufacturing Company, Hartford, Conn	4, 40, r. t
2 250	South Bend	South Bend M. C. Wks., South Bend, Ind	6, 55, t
2,285	Henderson	Henderson M. C. Co., Indianapolis, Ind.	6, 54, r. t
2,290	Abbott-Detroit	Abbott Motor Co., Detroit, Mich.	6, 50, r. t.
2,295	Palmer-Singer	Palmer & Singer Mfg. Co., Long Island City	6, 50, r. t
2,300	Franklin	H. H. Franklin Mfg. Co., Syracuse, N. Y.	6, 30, r. t.
2,300	Case	J. I. Case T. M. Co., Racine, Wis.	4, 40, t
2 300	Jeffery	Thos. B. Jeffery Co., Kenosha, Wis	6, 34, t.
2,350	Apperson	Apperson Bros. Auto. Co., Kokomo, Ind	6, 55, r. t
2,350	Kissel Kar	Kissel M. C. Co., Hartford, Wis.	6, 48, r. t
2,350	Stafford	Stafford M. C. Co., Kansas City, Mo.	4, 42, r. t
2,350	Mitchell	Mitchell-Lewis M. Co., Racine, Wis.	6, 60, t.
2,350	Velie	Velie M. Vehicle Co., Moline, Ill.	6, 50, r. t.
2,375	Howard	Howard M. C. Co., Connersville, Ind.	6, 60, t.
2,385	Halladay	A. C. Barley, Streator, Ill.	6, 50, t
2,400	Pullman	Pullman M. C. Co., York, Pa	6, 48, t
2,400	Stutz	Stutz M. C. Co., Indianapolis, Ind	6, 65, t.
2,485	Havers	Havers M. C. Co., Port Huron, Mich	6, 60, r. t
2,485	S & M	S. & M. Motor Co., Detroit, Mich	6, 48, r. t.
2,500	Colby	Colby Motor Co., Mason City, Ia	6, 60, t
2,500	Moyer	H. A. Moyer, Syracuse, N. Y.	4, 50, t.
2,500	Luverne	Luverne Auto. Co., Luverne, Minn.	6, 60, t
2,500	Grout	Grout Auto. Co., Orange, Mass.	6, 44, t
2,500	Dorris	Dorris M. C. Co., St. Louis, Mo	4, 30, t
2,500	A E C	Angar Engineering Co., Milwaukee, Wis	6, 50, t.
2,500	Pathfinder	Motor Car Mfg. Co., Indianapolis, Ind	4, 40, c.
2,500	White	The White Co., Cleveland, O.	4, 30, r. t
2,500	Imperial	Imperial Auto. Co., Jackson, Mich.	6, 45, t.
2,500	Croxton	Croxton M. C. Co., Washington, Pa	4, 35, t. ld
2,500	Apperson	Apperson Bros. Auto. Co., Kokomo, Ind	4, 45, t.
2,500	Cadillac	Cadillac M. C. Co., Detroit, Mich	4, 50, c. ld.
2,500	Chevrolet	Chevrolet Motor Co., Flint, Mich.	6, 40, t.
2,500	Studebaker	Studebaker Corp. of America, Detroit, Mich	6, 30, l.
2,550	Pratt	Elkhart C. & H. Mfg. Co., Elkhart, Ind	6, 60, t.
2,585	Kline Kar	Kline M. C. Corp., Richmond, Va	6, 50, r. t
2,590	McFarlan	McFarlan M. Co., Connersville, Ind	6, 50, r. t.
2,600	Cole	Cole M. C. Co., Indianapolis, Ind	6, 44, r. t.
2,600	Mercer	Mercer Automobile Co., Trenton, N. J	4, 31, r.
2,600	Oakland	Oakland M. C. Co., Pontiac, Mich	4, 48, s.
2,650	Firestone-Columbus	Columbus Buggy Co., Columbus, O	6, 55, t.
2,650	Burg	L. Burg Carriage Co., Dallas City, Ill	6, 60, t
2,650	Rayfield	Rayfield Motor Co., Chrisman, Ill.	6, 38, r. t.
2,685	Norwalk	Norwalk M. C. Co., Martinsburg, W. Va	6, 62, t.
2,700	Haynes	Haynes Auto. Co., Kokomo, Ind.	4, 29, c.
2,735	Premier	Premier Motor Mfg. Co., Indianapolis, Ind	6, 38, r. t.
2,750	Moon	Moon M. C. Co., St. Louis, Mo.	6, 58, c.
2,750	Staver	Staver Carriage Co., Chicago, Ill.	6, 65, t.
2,750	Lenox	Lenox M. C. Co., Hyde Park, Mass.	6, 60, t.
2,750	Pathfinder	Motor Car Mfg. Co., Indianapolis, Ind	6, 60, t.
2,750	Garford	The Garford Co., Elyria, O.	6, 44, t.
2,750	Inter-State	Inter-State Auto. Co., Muncie, Ind	6, 40, t.
2,785	Pilot	Pilot Motor Sales Co., Richmond, Ind.	6, 60, r. t.
2,800	Cadillac	Cadillac M. C. Co., Detroit, Mich	4, 50, l.
2,850	Pullman	Pullman M. C. Co., York, Pa.	6, 66, t.
2,850	Speedwell	Speedwell M. C. Co., Dayton, O.	6, 65, t.
2,850	W. F. S.	W. F. S. Motor Car Co., Philadelphia, Pa.	4, 40, r. t.
2,860	Premier	Premier Motor Mfg. Co., Indianapolis, Ind	6, 38, t.
2,900	Lyons-Knight	Lyons Atlas Co., Indianapolis, Ind.	4, 50, t.
2,900	Mercer	Mercer Automobile Co., Trenton, N. J	4, 32, t.
2,950	Speedwell	Speedwell M. C. Co., Dayton, O.	6, 55, t.
2,950	Franklin	H. H. Franklin Mfg. Co., Syracuse, N. Y.	6, 30, c.
2,975	Oldsmobile	Olds Motor Works, Lansing, Mich	6, 50, t.
2,985	Kline Kar	Kline M. C. Corp., Richmond, Va.	6, 60, r. t.
3,000	A. E. C	Anger Engineering Co., Milwaukee, Wis	6, 60, t.
3,000	Marmon	Nordyke & Marmon Co., Indianapolis, Ind	4, 32, r. t.
3,000	Cole	Cole M. C. Co., Indianapolis, Ind	6, 44, c.
3,000	W. F. S.	W. F. S. Motor Car Co., Philadelphia, Pa	6, 60, r. t.
3,100	Hudson	Hudson M. C. Co., Detroit, Mich.	6, 55, s.
3,100	Lyons-Knight	Lyons Atlas Co., Indianapolis, Ind.	6, 50, t.
3,150	Kissel Kar	Kissel M. C. Co., Hartford, Wis	6, 60, r. t.
3,150	National	National Motor Vehicle Co., Indianapolis, Ind.	4, 38, r.
3,200	Firestone-Columbus	Columbus Buggy Co., Columbus, O.	4, 40, t.
3,250	Winton	Winton M. C. Co., Cleveland, O.	6, 48, t.
3,250	Keeton	Keeton Motor Co., Detroit, Mich.	6, 48, r. t.
3,250	Lozier	Lozier Motor Co., Detroit, Mich.	6, 65, t.
3,250	Moyer	H. A. Moyer, Syracuse, N. Y.	6, 70, t.
3,250	Touraine	The Touraine Co., Philadelphia, Pa.	6, [illegible], t.
3,250	Pope	Pope Mfg. Co., Hartford, Conn.	4, [illegible], t.
3,250	Pope	Pope Mfg. Co., Hartford, Conn.	4, 50, t.
3,300	Knox	Knox Automobile Co., Springfield, Mass.	4, 40, r.
3,300	Franklin	H. H. Franklin Mfg. Co., Syracuse, N. Y.	6, 30, t.
3,300	McFarlan	McFarlan M. Co., Connersville, Ind.	6, 50, c.
3,300	National	National Motor Vehicle Co., Indianapolis, Ind.	4, [illegible], t.
3,300	White	The White Co., Cleveland, O.	4, 40, r. t.
3,350	Kissel Kar	Kissel M. C. Co., Hartford, Wis.	6, 48, c.
3,400	National	National Motor Vehicle Co., Indianapolis, Ind.	6, [illegible], t.

*Indicates price for chassis only, bodies to order.

(Concluded on page 32.)



"Here are the General Offices and Works of The Electric Storage Battery Co.—the largest storage battery plant in the country."

POWER FOR STARTING AUTOMOBILE ENGINES AND ELECTRIC LIGHTING

To start an automobile engine requires power—lots of it—especially in cold weather.

The real reason why electric starting and lighting apparatus has been so wonderfully reliable and is being almost universally adopted is because the storage battery has proved itself to be the most useful and efficient reservoir of energy for this purpose.

To crank an engine, a storage battery must develop from one-half to one horse power for a few seconds or minutes.

To light the lamps, it must develop about one-fifteenth horse-power for 8 to 15 hours without recharging.

It must receive and utilize the energy delivered it by the generator without waste. It must do its work, month in and month out, at temperatures ranging from below zero to 100° F.—instantly, automatically and cheerfully. It must demand (because it will receive) less care and attention than engine, gear box or any other vital part of the car.

THE "Exide" STARTING AND LIGHTING BATTERY

has been designed and constructed with a thorough knowledge of the varied character of the work it must do. It is made by a company that has had 25 years of experience in storage battery manufacture, covering every field in which storage batteries are used.

This company manufactures and has manufactured more storage batteries than all other battery makers put together. Two out of every three automobiles using electric self-starting and lighting apparatus are equipped with an "Exide" Battery. There are over 100,000 "Exide' Batteries now in service used for starting, lighting or ignition.

For electric vehicle propulsion "Exide" Batteries have for years been the standard among nearly all electric vehicle manufacturers and are to-day used by the largest electric vehicle owners. The large electric lighting companies use "Exide" Batteries as *reservoirs* of current for use in emergencies. They are used by the U. S. Government in 20 submarines, for firing large guns, for light-ships, for electric vehicles and for wireless apparatus. In New York City 182 storage battery street cars are propelled by "Exide" Batteries.

Unless you are a trained engineer, you cannot safely judge of the quality of a storage battery. Your best protection is to select a battery that is manufactured by a company having the necessary experience and facilities and a battery that has been approved by large battery users—those who are experts.

Your car is or will no doubt be equipped for electric self-starting and lighting.

REMEMBER, THE STORAGE BATTERY IS THE "HEART" OF THE SYSTEM.

You can be absolutely assured of dependable every-day service by using the "Exide" Battery. Insist upon the "Exide". Your dealer can secure it if *you* insist.

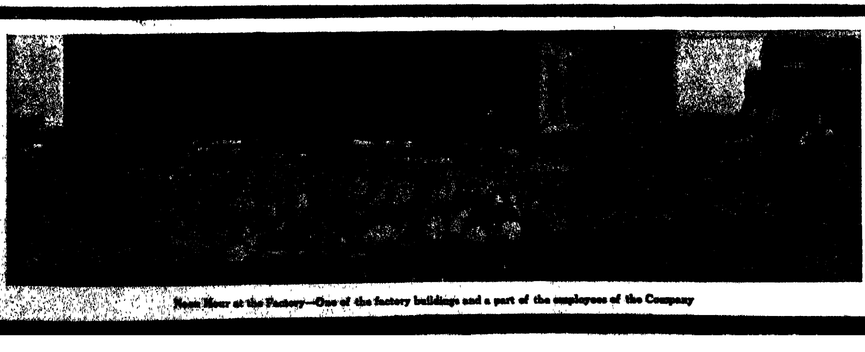
THE ELECTRIC STORAGE BATTERY CO.

Manufacturer of
The "Chloride Accumulator", The "Tudor Accumulator",
The "Exide", "Hycap-Exide", "Thin-Exide" and "Ironclad-Exide" Batteries

PHILADELPHIA, PA.
1888-1914

New York, Boston, Chicago, Denver, San Francisco, Seattle
St. Louis, Cleveland, Atlanta, Detroit, Los Angeles, Portland, Ore., Toronto

886 "Exide" Distributors
9 "Exide" Depots
"Exide" Inspection Corps



Noon Hour at the Factory—One of the factory buildings and a part of the employees of the Company

A Price List and Table of 1914 American Gasoline Pleasure Cars

(Concluded from page 26.)

Price	Name of Car	Name and Address of Manufacturer	No. of Cylinders, Horse-power and Body Type	Price.	Name of Car.	Name and Address of Manufacturer.	No. of Cylinders, Horse-power and Body Type.
$3,500	S G V	S G V. Co., Reading, Pa.	4, 36, r t.	$4,600	Winton	Winton M. C. Co., Cleveland, O.	[illegible]
3,500	Cunningham	J. Cunningham Sons & Co., Rochester, N Y.	4, 40, t.	4,600	Cunningham.	J. Cunningham Sons & Co., Rochester, N. Y.	[illegible]
3,500	Frontenac	Abendroth & Root Mfg Co., Newburgh, N. Y	4, —, t	4,650	Kissel Kar	Kissel M. C. Co., Hartford, Wis	[illegible]
3,500	Marmon	Nordyke & Marmon Co, Indianapolis, Ind	6, 41, r t	4,850	Stearns-Knight	F. B. Stearns Co., Cleveland, O.	[illegible]
3,500	Norwalk	Norwalk M. C Co, Martinsburg, W Va	6, 74, t	5,000	Pierce-Arrow	Pierce-Arrow M. C. Co., Buffalo, N. Y.	[illegible]
3,500	California Six	Cole California Car Co, Oakland, Cal	6, 44, r t	5,000	Stevens-Duryea	Stevens-Duryea Co., Chicopee Falls, Mass	[illegible]
3,500	Knox	Knox Automobile Co., Springfield, Mass	4, 40, t.	5,000	Packard	Packard M. C. Co., Detroit, Mich.	[illegible]
3,500	S & M	S & M. Motor Co., Detroit, Mich	6, 48, l	5,000	Marmon	Nordyke & Marmon Co., Indianapolis, Ind	[illegible]
3,500	Rayfield	Rayfield Motor Co., Chrisman, Ill	6, 38, c	5,000	Peerless	Peerless M. C. Co., Cleveland, O.	[illegible]
3,525	Palmer-Singer	Palmer & Singer Mfg Co, Long Island City	6, 70, t	5,000	White	The White Co., Cleveland, O.	[illegible]
3,600	Chalmers	Chalmers Motor Co., Detroit, Mich.	6, 40, l.	5,000	Austin	Austin Automobile Co., Grand Rapids, Mich	[illegible]
3,600	Dorris	Dorris M. C Co, St. Louis, Mo.	4, 30, l.	5,000	Austin	Austin Automobile Co., Grand Rapids, Mich.	[illegible]
3,750	Stearns-Knight	F. B. Stearns Co., Cleveland, O	4, 30, r. t	5,000	Fiat	Fiat Automobile Co., Poughkeepsie, N. Y.	[illegible]
3,850	Packard	Packard M. C Co, Detroit, Mich.	6, 38, r t	5,000	Stearns-Knight	F. B. Stearns Co., Cleveland, O.	[illegible]
3,975	Keeton	Keeton Motor Co., Detroit, Mich	6, 48, l.	5,100	Locomobile	Locomobile Co. of America, Bridgeport, Conn.	[illegible]
4,000	Premier	Premier Motor Mfg Co., Indianapolis, Ind	6, 48, r. t	5,500	Knox	Knox Automobile Co., Springfield, Mass.	[illegible]
4,000	Cole	Cole M C Co., Indianapolis, Ind	6, 44, l	5,500	Chadwick	Chadwick Eng. Wks., Pottstown, Pa	[illegible]
4,000	Austin	Austin Automobile Co., Grand Rapids, Mich.	6, 55, r. t.	5,500	Simplex	Simplex Auto. Co., New Brunswick, N. J.	[illegible]
4,000	Fiat	Fiat Automobile Co, Poughkeepsie, N Y	4, 35, r. t p.	5,700	Locomobile	Locomobile Co. of America, Bridgeport, Conn.	[illegible]
4,100	Kissel Kar.	Kissel M. C Co, Hartford, Wis	6, 48, l.	6,000	Stevens-Duryea	Stevens-Duryea Co., Chicopee Falls, Mass	[illegible]
4,250	S G V	S G V Co, Reading, Pa	4, 36, c. l. ld.	6,000	Simplex	Simplex Auto. Co., New Brunswick, N. J.	[illegible]
4,300	Pierce-Arrow	Pierce-Arrow M C. Co, Buffalo, N. Y	6, 38, t	6,000	Austin	Austin Automobile Co., Grand Rapids, Mich.	[illegible]
4,300	Oldsmobile	Olds Motor Works, Lansing, Mich	6, 50, l.	6,000	Fiat	Fiat Automobile Co., Poughkeepsie, N. Y.	[illegible]
4,300	Peerless	Peerless M. C Co, Cleveland, O	6, 38, l.	6,100	Stearns-Knight	F. B. Stearns Co., Cleveland, O.	[illegible]
4,300	Lyons-Knight	Lyons Atlas Co, Indianapolis, Ind	4, 50, b	6,300	White	The White Co., Cleveland, O.	[illegible]
4,350	Winton	Winton M C Co, Cleveland, O.	6, 48, c l.	6,500	Chadwick	Chadwick Eng. Wks., Pottstown, Pa.	[illegible]
4,400	Locomobile	Locomobile Co of America, Bridgeport, Conn.	6, 63, r t	6,500	Simplex	Simplex Auto. Co., New Brunswick, N. J.	[illegible]
4,450	Stearns-Knight	F B Stearns Co, Cleveland, O.	4, 30, c	7,000	Peerless	Peerless M. C. Co., Cleveland, O	[illegible]
4,500	Fiat	Fiat Automobile Co, Poughkeepsie, N Y	4, 55, r t. p.	7,000	Austin	Austin Automobile Co., Grand Rapids, Mich.	[illegible]
4,500	Knox	Knox Automobile Co., Springfield, Mass	6, 46, r t	7,100	Pierce-Arrow	Pierce-Arrow M. C. Co., Buffalo, N. Y.	[illegible]
4,550	Stevens-Duryea	Stevens-Duryea Co., Chicopee Falls, Mass	6, 45, r. t.	8,000	Crane	Crane M. C. Co., Bayonne, N. J.	[illegible]

Abbreviations used in the list r Roadster, t. Touring Car, l. Limousine, c. Coupe, ld. Landaulet, p. Phaeton, b. Berline; s. Sedan. *Indicates price for chassis only; bodies to order.

American Electric Pleasure Cars of 1914: Their Makers and Prices

A Table Designed to Answer the Question: "What Electric Pleasure Car is Within My Price?"

Price.	Name of Vehicle	Name and Address of Manufacturer	Passenger Capacity and Type of Body	Price.	Name of Vehicle.	Name and Address of Manufacturer.	Passenger Capacity and Type of Body.
$1,550	Hupp-Yeats	R-C-H Corporation, Detroit, Mich	2, Torpedo	$2,900	Bailey	S R. Bailey & Co., Boston, Mass.	2, Roadster.
1,750	Hupp-Yeats	R-C-H Corporation, Detroit, Mich	4, Regent	2,900	Buffalo	Buffalo Electric Vehicle Co, Buffalo, N Y	4, Coupé
1,990	Standard	Standard Electric Car Co, Jackson, Mich	4, Coupé	2,900	Borland	Borland-Grannis Co., Chicago, Ill.	5, Coupé.
2,000	Fritchle	Fritchle Auto and Battery Co, Denver, Col	2, Victoria.	2,900	Ohio	Ohio Electric Car Co., Toledo, O	4, Coupé.
2,150	Columbus	Columbus Buggy Co, Columbus, O.	2, Roadster	2,950	Grinnell	Grinnell Electric Car Co., Detroit, Mich.	4, Coupé.
2,150	Hupp-Yeats	R-C-H Corporation, Detroit, Mich	4, Patrician.	3,000	Anderson	Anderson Electric Car Co., Detroit, Mich.	5, Brougham.
2,200	Dayton	Dayton Electric Car Co, Dayton, O	2, Victoria	3,000	Buffalo	Buffalo Electric Vehicle Co., Buffalo, N. Y.	5, Brougham
2,250	Columbus	Columbus Buggy Co Columbus, O	4, Stanhope.	3,000	Chicago	Chicago Electric Motor Car Co., Chicago, Ill.	4, Limousine.
2,300	Anderson	Anderson Electric Car Co, Detroit, Mich	4, Victoria	3,000	Columbus	Columbus Buggy Co., Columbus, O	5, Coupé.
2,300	Baker	Baker Motor Vehicle Co, Cleveland, O	2, Roadster	3,000	Woods	Woods Motor Vehicle Co., Chicago, Ill	4, Brougham.
2,350	Columbus	Columbus Buggy Co, Columbus, O	4, Coupé	3,100	Argo	Argo Electric Vehicle Co., Saginaw, Mich.	5, Limousine.
2,500	Tiffany	Tiffany Electric Car Co, Pontiac, Mich	5, Coupé.	3,100	Baker	Baker Motor Vehicle Co., Cleveland, O.	5, Brougham.
2,500	Argo	Argo Electric Vehicle Co, Saginaw, Mich	4, Roadster	3,100	Broc	Broc Electric Vehicle Co., Cleveland, O.	5, Brougham.
2,500	Bailey	S R Bailey & Co, Boston, Mass.	2, Roadster	3,100	Rauch & Lang	Rauch & Lang Carriage Co., Cleveland, O	5, Coach.
2,500	Fritchle	Fritchle Auto and Battery Co, Denver, Col	5, Touring	3,150	Waverley	The Waverley Co, Indianapolis, Ind	4, Brougham.
2,500	Woods	Woods Motor Vehicle Co, Chicago, Ill	3, Roadster	3,200	Ohio	Ohio Electric Car Co., Toledo, O	5, Brougham.
2,550	Anderson	Anderson Electric Car Co, Detroit, Mich	4, Brougham.	3,200	Grinnell	Grinnell Electric Car Co., Detroit, Mich.	5, Coupé.
2,550	Borland	Borland-Grannis Co, Chicago, Ill	3, Roadster	3,200	Woods	Woods Motor Vehicle Co., Chicago, Ill	5, Brougham.
2,550	Detroit	Detroit Electric Vehicle Co, Detroit, Mich	4, Brougham	3,200	Ohio.	Ohio Electric Car Co., Toledo, O	5, Coupé-Br'gm
2,600	Buffalo	Buffalo Electric Vehicle Co, Buffalo, N Y	2, Roadster	3,250	Century	Century Electric Car Co., Detroit, Mich	5, Brougham.
2,600	Rauch & Lang	Rauch & Lang Carriage Co, Cleveland, O	3, Roadster	3,300	Bailey	S. R. Bailey & Co, Boston, Mass.	4, Roadster.
2,650	Century	Century Electric Car Co, Detroit, Mich	4, Coupé	3,300	Chicago	Chicago Electric Motor Car Co., Chicago, Ill.	5, Limousine.
2,700	Dayton	Dayton Electric Car Co, Dayton, O	4, Coupé	3,400	Grinnell	Grinnell Electric Car Co., Detroit, Mich.	5, Brougham.
2,800	Argo	Argo Electric Vehicle Co, Saginaw, Mich	4, Brougham	3,500	Ohio	Ohio Electric Car Co., Toledo, O	5, Colonial.
2,800	Baker	Baker Motor Vehicle Co, Cleveland, O	4, Coupé.	3,500	Waverley	The Waverley Co., Indianapolis, Ind.	5, Limousine.
2,800	Rauch & Lang	Rauch & Lang Carriage Co, Cleveland, O	4, Brougham	3,500	Ohio	Ohio Electric Car Co., Toledo, O	5, Coupé.
2,800	Waverley	The Waverley Co Indianapolis, Ind	4, Coupé.	3,600	Broc	Broc Electric Vehicle Co., Cleveland, O.	5, Brougham.
2,850	Detroit	Detroit Electric Vehicle Co, Detroit, Mich	4, Rdstr & Bg	3,600	Fritchle	Fritchle Auto. and Battery Co., Denver, Col.	5, Brougham.
2,900	Broc	Broc Electric Vehicle Co, Cleveland, O	4, Brougham	3,800	Rauch & Lang	Rauch & Lang Carriage Co., Cleveland, O	7, Limousine.
2,900	Ohio	Ohio Electric Car Co, Toledo, O	5, Brougham.	5,500	Borland	Borland-Grannis Co, Chicago, Ill	7, Limousine.

Retrospect of the Year 1913

(Concluded from page 7.)

structions laid upon this specimen by conflicting authorities. At present all evidence seems to be in favor of the view that a race of man somewhat similar to modern civilized man has existed for a very long period of time, and was coeval with the very low Heidelberg and similar types. Reports of the experimental solar power plant in Egypt are very encouraging, and we shall look with interest for further developments in this direction. Molecular physics continues to be one of the most actively developing fields of research. We have come to look upon atomic weight as not necessarily defining one single element—several elements may have the same, or very nearly the same atomic weights, according to the point of view developed by Prof. Soddy. Dr Hevesy, speaking at the British Association on "Radioactive Elements as Indicators in Physics and Chemistry," pointed out the extreme delicacy of radioactive methods of observation: "By means of an α ray electroscope it is possible to measure exactly as small a quantity as 10^{-11} grammes of radioactive substance having a half-period of one hour." By the aid of such methods 10^{-6} milligrammes of lead is quantitatively determinable. Sir Oliver Lodge's address attracted considerable popular attention, mainly on account of his reference to spiritualistic phenomena. It can hardly be said to have brought to light any strikingly new facts or viewpoints. Wireless telegraphy in the service of meteorology and allied sciences has won a triumph in the establishment of radio-telegraphic connection between the Eiffel Tower, Paris, and the radio tower at Arlington, Va., near Washington, D. C. In the field of eugenics the camp has recently suffered a somewhat sharp scission. The general of the American forces, Prof. Davenport, has advocated the doctrine "let the weak wed the strong," as opposed to the Pearsonian doctrine "let the strong wed the strong." Davenport contends that the doctrine of the English school is theoretically correct, but practically incapable of application, as it would restrict marriages to a point suicidal to the race. With all these discussions as to what eugenic practice ought to be, one is led to wonder what actual practice is. Has the preaching of the eugenist had any measurable effect? Perhaps this can be claimed for it, that it has influenced legislation in favor of restricting the offspring of defectives. The Pasteur Institute has just celebrated its twenty-fifth anniversary—and what institution can show a record of greater success and usefulness for the same period than this great life-saving station? Two records made during the year seem to deserve special mention. The highest altitude reached by a sounding balloon has been raised from 20.15 to 23.4 miles. Mount McKinley has been scaled by Archdeacon Hudson Stuck and his party.

Obituary.

In noting briefly—as needs we must—the death roll of the past year, we mention first the death of John Fritz, a pioneer ironmaster, and one of the most distinguished manufacturers in that iron and steel industry in which this country leads the world. Fritz was the typical successful American inventor. Born of German and Scotch parents in 1822, he picked up his practical education while working on a farm. In 1844, as an apprentice to a mill for rolling bar iron, he came into touch with the great industry in which he was to become a leading figure. When the Bessemer process was introduced into this country Fritz, with Holley and Jones, applied his genius to the improvement of the process. By taking up the manufacture of armor plate, he assisted in the re-creation of our navy. The universities owe much to his influence and assistance, and he was honored by the engineering societies, both of this country and Great Britain. He founded the John Fritz Gold Medal, and his personal qualities made him endeared to the whole engineering fraternity.

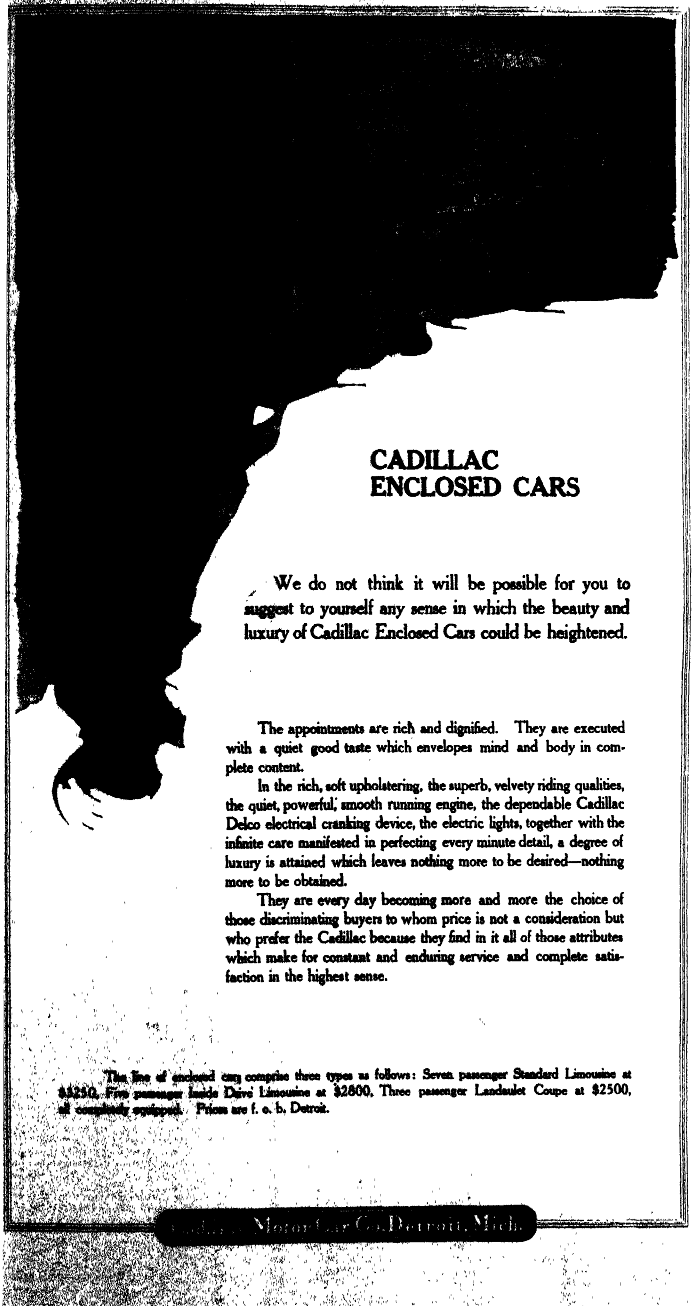
In Sir William White the world lost its most distinguished and widely known naval architect. For many years he was the Director of Naval Construction and Assistant Controller of the Royal Navy; and no architect has left so strong an imprint upon warship design. As consulting architect for the "Mauretania" and "Lusitania" he had much to do with the design of these famous vessels. Knighthood was but one of many distinguished honors conferred upon Sir William during his long and exceedingly active life.

In Gustav de Laval, the technical world lost one of its most brilliant inventors. It has been estimated that the cream separator and milk tester devised by him saved millions of dollars to the world's dairy interests alone. He was a pioneer in the construction of the steam turbine. Like Fritz and White, he combined with his inventive and constructive ability the advantages of great worth of character.

Another deplorable loss of the year was the untimely death of Rudolph Diesel, the inventor of the famous oil engine which bears his name. His fame may well rest upon the results already achieved with his invention. What the future has in store can be only surmised; but it is certain that the Diesel engine will take rank with the Parsons turbine as marking one of the epochs in that development of prime movers which opened with the work of James Watt.

The passing of Alfred Russel Wallace reminded those who knew, and informed the great multitude who did not know, that this distinguished scientist was the co-founder with Darwin of the modern theory of evolution. Strange indeed it was that two men at opposite ends of the earth should have worked out, unknown to each other, an identical solution of the problem of the genesis of species. But so it was. Wallace was far from being a narrow pedant, wedded to his specialty to the exclusion of other matters; for he was a man of broad interests and deep sympathy. He leaves his luminous writings as a monument to his industry and his long sustained devotion to the advancement of truth.

The death of Lieut. Col. C. D. Gaillard, after his return from the Panama Canal in broken health, was recognized as one more instance of the sacrifice of self to duty, of which there are so many brilliant examples among the naval and military men of this country. To Col. Galliard, who, for six years, had charge of the excavation of the Culebra cut, was due the wonderful organization which enabled that stupendous work to be done with the speed and economy which marked its progress. Somewhere in the great cut, a grateful country should erect a fitting monument to the technical skill and personal devotion of this distinguished army engineer.



CADILLAC ENCLOSED CARS

We do not think it will be possible for you to suggest to yourself any sense in which the beauty and luxury of Cadillac Enclosed Cars could be heightened.

The appointments are rich and dignified. They are executed with a quiet good taste which envelopes mind and body in complete content.

In the rich, soft upholstering, the superb, velvety riding qualities, the quiet, powerful, smooth running engine, the dependable Cadillac Delco electrical cranking device, the electric lights, together with the infinite care manifested in perfecting every minute detail, a degree of luxury is attained which leaves nothing more to be desired—nothing more to be obtained.

They are every day becoming more and more the choice of those discriminating buyers to whom price is not a consideration but who prefer the Cadillac because they find in it all of those attributes which make for constant and enduring service and complete satisfaction in the highest sense.

The line of enclosed cars comprise three types as follows: Seven passenger Standard Limousine at $3250, Five passenger Inside Drive Limousine at $2800, Three passenger Landaulet Coupe at $2500, all completely equipped. Prices are f. o. b. Detroit.

Cadillac Motor Car Co. Detroit, Mich.

How British authorities regard the Cadillac two-speed axle

"The Autocar" says

"It would be difficult to outline an ideal car without this feature."

In conjunction with the recent award of the Dewar Trophy to the Cadillac—the second time within five years that this treasured mark of merit has been bestowed on the Cadillac—it is interesting to note how British automobile authorities regard the Cadillac's two-speed direct drive axle.

This axle was even more of an innovation in Great Britain and Europe than in the United States; but it is very evident, from published comments, that it has found immense favor among those qualified to speak with authority on the subject of motor car advancement

The Autocar, one of the leading motor publications of England, declaring it would be difficult to outline an ideal car that did not incorporate this feature, says:

"When the Cadillac system of combining ignition, lighting and engine starting in one electrical system was introduced two years ago, it was very properly regarded as a bold step; experience has shown it to be as successful as it was bold Today the Cadillac designers have made another innovation, which, personally, we regard as even a greater improvement than the very important one of two years ago As a basis, they have taken the old idea of two pairs of bevel gears, either pair working alternately and giving the car two different gear ratios; but the way in which the Cadillac designers have adopted it is new, and the working results are not merely satisfactory; they are so good that they mark a distinct forward step toward the long sought ideal of direct and noiseless gears on all speeds.

"We have had a good bit of experience with high geared fourth speeds, the direct drive on the third speed and the indirect on the fourth. We found these indirect fourths pleasant to use, but the moment we put in the high indirect fourth, the gear box began to make its working apparent Now, with the Cadillac one gets all the advantages of the high fourth, but without the noise, it simply, as it were, calms down on the engine without any counter balancing noise or other objection

"After once experiencing the delight of two direct and noiseless drives one feels that it is difficult to outline an ideal car which does not contain this feature, and we feel fairly safe in asserting that the Cadillac successful reintroduction of an old idea will be followed by other makers"

"The Motor," another British technical authority, comments

"We have always held the Cadillac in the highest esteem, and admired it as a criterional example of high-grade American construction. The charm of the dual drive to the rear axle is compelling and entrancing, and as one merely touches the little lever at the side and, on depressing and allowing the clutch to rise, finds a higher direct drive available, wonderment is aroused as to the undoubtedly simple manner in which so great an advantage has been brought about.

"The luxury of driving a touring car at 20 or 25 miles an hour with a direct drive and final gear ratio of 2.5 to 1 is quite a new fascination."

From "Horseless Age."

"It seems at least possible that the two speed axle may confer upon the four-cylinder car sufficient flexibility and accelerative ability, without recourse to noisy geared speeds, to satisfy the public demand for these qualities, and, if this should prove to be the case, the demand for six-cylinder cars, with their somewhat more costly, more bulky, more complicated and less economical motors, might be materially reduced. It can hardly be doubted that the advent of the double-direct drive is one of the most important happenings of recent years in the automobile industry."

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

LOW CUT SHOE ATTACHMENT.—W. E. BUNKER, Natick, Mass. This invention relates to "pumps" or low cut shoes, and provides an attachment to prevent the shoe from spreading or gaping in the movements of walking. The invention provides a stiffener whose use will not result in discomfort at the back of the heel, and the stiffener may be readily attached to any low cut shoe.

WARDROBE TRUNK.—M. CHERRY, JR., 226 5th Ave., Larchmont Manor, N. Y. The object of the invention is to provide a simple, strong and compact carriage, which will accommodate hangers, extending through the entire width of the trunk and will prevent any displacement of the hangers when engaged in the same carriage frame.

LOCKING DEVICE FOR CLASPS.—M. SCHIFF, care of Samuel D. Schwitzer, 309 Broadway, N. Y., N. Y. This device is for use as the clasp of a bracelet, necklace or other article of jewelry, and is arranged to prevent accidental opening of the clasp, to be inconspicuous and avoid marring of the appearance of the article, and to present no undesirable projection on the surface of the article.

Electrical Devices.

ELECTRIC FIRE ALARM.—F. RICORDS and M. LEWRY, care of the latter, 573 Washington Ave., Brooklyn, N. Y. This alarm relates to alarms which may be installed in a building with an indicator on each floor having a bell and a switch, with electrical connections for ringing all the bells and for lighting a certain lamp on each floor when an alarm is given, by closing one of the switches.

ELECTRIC-MOTOR DRIVING UNIT.—M. TAIGMAN, 239 Wooster St., New York, N. Y. The invention pertains to improvements in individual motor equipments for power driven machines, and more particularly to equipments to be installed for operating bench machines and controlled by means of foot operated devices.

Of Interest to Farmers.

COMBINATION CUSHIONED FLAT AND FILLER.—W. MERKER, 22 Covert St., Brooklyn, N. Y. The purpose in this case is to provide a cushioned flat and filler arranged to reduce breakage of eggs while in the egg carrier to a minimum and to protect the members forming the filler from being bent or broken, thus insuring long life of the egg carrier and permitting its re-use for a long period.

CORN PLANTER.—E. J. OGDEN, 502½ N. Sixth St., Springfield, Ill. The invention more particularly is directed to an improved means for actuating the seed dropping mechanism whereby the seed may be deposited at certain intervals in the ground. The principal object is to provide a planter having efficient means for actuating the seed dropping mechanism.

IRRIGATING APPARATUS.—G. S. WILLIAMSON, Elk Grove, Cal. The purpose here is to supply an apparatus adapted for use in sprinkling large fields and the like, the liquid employed in sprinkling being adapted to operate the sprinkling mechanism. For this, use is made of a track pipe line provided with valves, and a carriage mounted to operate over the track pipe line and moved by the liquid taken from the track pipe line through the said valves, and transmitted to operating means on the carriage after which the said liquid is ejected from a sprinkler mounted on the carriage.

IRRIGATING APPARATUS.

Of General Interest.

FORM FOR CEMENT CISTERNS.—G. A. WATKINS, Columbus, Ohio. This invention relates to a form for cement cisterns and is particularly devised to produce a knock-down form to attain such result in a manner to permit of the removal of independent sections constituting the form without in any way decreasing the security of the remaining parts in their proper position.

STREAM DEFLECTOR.—W. H. DEAN, P. O. Box 58, Morningside, Sioux City, Iowa. The inventor provides a deflector more especially designed for use in rivers and other waterways, and arranged to divert or deflect the current of the waterway with a view to prevent the same cutting into the bank, to maintain a channel along a proper predetermined line and to insure the formation of a permanent shore line.

MILK BOTTLE HOLDER.—J. J. DUNN, 4580 Park Ave., New York, N. Y. This invention provides a holder locked in holding position only when having contained therein a capped or filled bottle, to avoid interference or meddling; provides a holder mountable upon the frame of a door or window, which may be released only by opening the door or window; provides a holder temporarily mounted beside a door or window which may be removed during the intervals between the delivery of the bottles containing the milk; and provides a holder to operate in conjunction with a door or window sill or other rest, which when locked is held in position by the adjacent door or window.

PROPELLER.—H. D. F. BAGLEY, care of E. Brimfield Hampden Co., Holland, Mass. This inventor provides a propeller having a maximum of efficiency in developing speed from a given power, and provides a form and arrangement of blades that will present a maximum of surface to the water at the hub and yet minimize the cavitation.

BANJO, DRUM, OR SIMILAR MUSICAL INSTRUMENT.—C. HABERMANN, care of Oscar Schmidt, 87 Ferry St., Jersey City, N. J. This invention provides improvements in banjos, drums, or similar musical instruments, whereby a sharp, clear and melodious tone is produced, and the construction of the means for drawing and holding the tightening ring in place is simplified and a finer appearance is given to the instrument.

BOTTLE CLOSURE.—H. V. PICK, care of Bernard Noonan, 835 Columbus Ave., N. Y., N. Y. This bottle closure is especially adapted for use with the form of bottles having a long neck as a handle portion. It is also adapted to snugly fit about the mouth of the bottle, so as to prevent the entrance of dirt, dust or any foreign material to the liquid in the bottle.

DEVICE FOR APPLYING SUBSTANCES TO TREES, SHRUBS AND VINES.—W. R. KLECKNER, Cowell, Cal. By means of this device an insecticide or other substance may be so applied to a tree, shrub, or vine, as to enable the sap to readily take up such substance. It will prevent injury to the growths named, and will prevent leakage and waste of the substance to be applied thereto.

Heating and Lighting.

PIPE SUPPORT.—W. B. GRAY, 1327 South 22nd St., Louisville, Ky. This is an improvement in traveling supports for pipes, and the aim is to provide a safe and simple device for supporting heating and power pipes, wherein means is provided for permitting the expansion and contraction of the pipes without injury to the pipe or to the support. Mr. Gray has invented another device for supporting heating and power pipes wherein means is provided for permitting the expansion and contraction of the pipes without injury to the said pipes or to the support.

FILAMENT LAMP.—M. SIDON, 616 W. 182nd St., New York, N. Y. This invention relates generally to filament lamps and more particularly it involves a lamp of this type in which the bulb is made of a plurality of parts adapted to fit closely together whereby the proper vacuum within the bulb may be secured.

AUTOMATIC FURNACE DAMPER.—A. W. ARNOLD, Goshen, Ind. This improvement relates to dampers or draft governors which are designed to operate automatically under the influence of the draft itself to maintain a substantially uniform combustion of fuel, in accordance with the conditions for which the devices may be adjusted.

VALVE FOR GAS BURNERS.—E. S. ALLEN, 517 W. 184th St., New York, N. Y. The more particular purpose of the inventor is to produce an article having a number of its movable parts located within a sleeve forming a part of the burner and rendered detachable for the purpose of facilitating the removal and replacement of said movable parts.

Household Utilities.

FLY PAPER HOLDER.—J. R. SMITH, Stella, Mo. This invention relates to insecticides, and has particular reference to a means for holding ordinary sticky fly paper to prevent the same from being exposed in an unsightly and unsanitary manner, and at the same time will be held from being blown about by puffs of wind or the like.

CURTAIN FIXTURE.—H. REUBEL, 107 E. 17th St., Manhattan, N. Y., N. Y. This fixture is arranged to permit of conveniently placing the curtain rod in position on the supporting brackets to securely hold the curtain rod in place on the brackets, and to allow of placing the fixture directly under an overhanging or projecting molding or the like.

Machines and Mechanical Devices.

TICKET DEPOSIT BOX.—J. ANDERSON, 408 Grand View Ave., Ridgewood, N. Y. This invention provides means for canceling, exhibiting and depositing tickets mechanically and outside of the control of the attendant; provides for preventing the extracting of tickets from the deposit box after being placed therein, and provides a mechanism for operating the canceling and depositing devices which is simple, efficient and durable in construction.

CONTROL OF BRUSHES.—M. VANDAL, 8 Rue St. Augustin, Paris, France. The invention pertains to improvements in control of brushes whereby to communicate to two sets of brushes, having each one or more brushes, both a reciprocating and a circular motion in the brushing plane. The combination of these motions is for the purpose of distributing any material, such as color for instance, equally on any surface plane or substantially so.

EXPANSION LIFT.—M. L. [illegible], [illegible] Fairmont Ave., Jersey City, N. J. This inventor provides a mechanism having a pivoted base to permit a lateral swing of said mechanism thereon; provides a thrust member for said mechanism, pivotally mounted thereon to rock in a plane perpendicular to the plane of rotation of said base; and provides a mechanism having terminal thrust members and a flexible expansion member to connect the thrust members, and pivotally connected with these members to permit disposition thereof in angularly disposed planes.

SAFETY GEARING FOR DRILLS.—J. O. FOSTER, Peculiar, Mo. It is sought in this invention to provide cushioning mechanism interposed between relating movable parts of the winding mechanism, and so arranged that when the drill is dropped, the shock upon the gearing is cushioned and the consequent damages to the gearing are reduced to a minimum.

Prime Movers and Their Accessories.

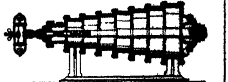
JOINTING APPARATUS FOR BOILER TUBES.—S. A. DUGAN, [illegible], Canal Zone, Panama. The device secured by this patent is for joining the tubes of steam boilers to the tube sheets. The inventor produces an annular depression in the sheet to receive the tube, and he employs for the purpose a hollow shaft having radially movable rollers which are gradually expanded by a tapered spindle, the spindle shank being threaded and receiving a nut fitting in a recess in the shaft.

INTERNAL COMBUSTION ENGINE.—F. D. CALKINS and A. C. JOHNSON, Sunnyvale, Cal. The invention has for its purpose to provide means for controlling the admission and exhaust of the motive fluid, wherein a continuously rotating valve having a large bearing surface is provided separated from the explosion chamber of the engine by a water jacket, and arranged to automatically compensate for wear. The inventors have patented another internal combustion engine which provides on an engine a rotating valve having a large wearing surface and separated from the explosion chamber in order to prevent heating and deposits of carbon, and wherein means is provided for automatically compensating for the wear on the valve.

Prime Movers and Their Accessories.

ROTARY PUMP.—A. F. FORD, 1165 Pine St., Walla Walla, Wash. This invention has reference to improvements in rotary pumps, and has for an object the provision of an improved structure in which the pumping apparatus may be arranged to operate as a horizontal pump or a vertical pump.

ROTARY ENGINE.—G. E. CALLAWAY, Jonesboro, La. Address J. M. Beadley, secretary. This engine provides a series of casings successively increasing in diameter, and the steam is used expansively in each casing in succession. The shaft extending through the several casings carries rotors of elliptical form which coact with vanes and abutments against which the steam acts, and special governor elements are associated with the engine.



ROTARY ENGINE.

Railways and Their Accessories.

LOCOMOTIVE AXLE BEARING.—W. C. STEPHENSON, Rocky Mount, N. C. Journal blocks or bearings of locomotives are commonly inserted from below in slots provided in the frame and secured by wedges called "wedge-bolts." When the last break or require removal or replacement, it is necessary to first remove the horizontal bar, or so-called "binder," by which the wedge-bolt is supported. The object here is to provide an improvement whereby the removal of the wedge-bolt can be very easily and quickly effected.

Pertaining to Recreation.

PIN SETTER FOR BOWLING ALLEYS.—R. SCHLOSSBERG, 1007 Metropolitan Ave., Brooklyn, N. Y. The invention refers more particularly to means for centering the tenpins, which means comprise a plate or platform provided with openings for the pins and means for actuating the plate. The pin setter indicates to the players that the pins are set in the proper places.

Pertaining to Vehicles.

HORSE DETACHER.—R. [illegible] and W. H. CORDER, North Carrollton, Miss. An object of this invention is to provide means whereby a horse which is harnessed to a vehicle may be liberated therefrom, such means consisting in a device for detaching the traces, the hold-back, and the bellybands, thus permitting the horse to emerge from between the shafts clear of the vehicle.

SIGN AND INDICATOR.—F. [illegible], care of V. Piccio, 1015 Franklin St., Tampa, Fla. [illegible]

[illegible] STREET CLEANER'S CART.—[illegible], 406 So. Warren St., Trenton, N. J. In this patent use is made of a cart body having means to detachably hold a bag or sack, and an endless chain is mounted within the body of the cart and carries buckets [illegible]

STREET CLEANER'S CART.

adapted to dump the material into the sack, there being a bevel pan and appurtenances at an opening provided in the body at the side opposite the sack whereby the street cleaner may sweep the material in the street into a carrier bucket presented at the opening. Means are provided to lock the chain with an empty bucket disposed at the receiving opening.

DEMOUNTABLE RIM.—L. A. GORDON, 168 Barclay St., Fall River, Mass. The rim is especially for use in wheels having pneumatic tires, for permitting the rim which directly supports the tire to be demounted from the wheel, in order to facilitate the removal of the tire from engagement with the rim. Means are provided whereby the rim may be mounted on wheels having ordinary rims of the clincher or quickly separable type, without requiring changes in the rim itself.

Pertaining to Vehicles.

AUTOMOBILE VEIL.—M. SALZ, 30 W. 32nd St., New York, N. Y. This veil is designed especially for ladies' use, and the object of the invention is to provide a veil designed more especially for use when automobiling or the like, to protect the wearer from excessive air currents and dust, thus permitting the taking of a trip with increased comfort and enjoyment.

HARNESS ATTACHMENT FOR SECURING NETS AND BLANKETS.—F. H. MCCORMICK, 19 Charles St., Hillsdale, Mich. The device comprises a bucklelike frame, a prong or tongue pivoted thereto, and a spring for holding said prong in either of two positions, to wit, folded as when engaged with net or blanket, or extended laterally as when serving as a rein-guard.

AUTOMOBILE JACK.—J. DE H. BUNN, Address Dr. Philip R. Koons, 33 West Main St., Mechanicsburg, Pa. The purpose here is to provide a device by means of which an automobile or like vehicle may be lifted clear of the ground or other supporting surface and held in such position as long as necessary, and wherein the device is capable of adjustment for different heights.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

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DELCO

ELECTRIC CRANKING LIGHTING IGNITION

A Delco Equipped Car Has Won the World's Greatest Automobile Honors

An American motor car equipped with the Delco Electric Cranking, Lighting and Ignition System has been awarded the famous Dewar Trophy by the Royal Automobile Club of England.

The Delco system itself did not win this highly prized trophy, but it was so severely tested in the trials, and the record it made was so remarkable, that some facts regarding it are bound to be of interest to motor car owners.

The trials that determined the award of the Dewar Trophy involved driving 1,000 miles over all sorts of roads at an average speed of 19.5 miles an hour. *This is somewhat misleading, however, as an exceptionally high rear axle gear ratio was used throughout the trial and the actual speed at which the electric generator was driven was the equivalent of only 13.2 miles per hour with a standard rear axle.*

During the entire trial, which lasted 66 hours and 17 minutes, or more than three days and two nights, all electric lights were burned continuously.

Actual driving time, however, was only 51 hours. For over 15 hours all lamps were burned, while no current was being generated.

The cranking device was used 130 times; an average of once every 30 minutes during the entire 66 hours. And at the end of the trial the batteries were still sufficiently charged to crank the engine 1000 compressions and burn the side, tail and speedometer lights 20 additional hours.

In other words, in spite of the heavy and continuous drain on the batteries for over 66 hours, while the generator was being run at unusually low speed for only 51 hours, the battery was still well charged at the end of the trial.

Another very gratifying phase of the Committee's report is found in the statement that—"IT WAS OBSERVED AND NOTED THAT THE IGNITION WAS PERFECT THROUGHOUT THE TRIAL."

And yet while this entire performance of the Delco equipment is very wonderful, it is not at all surprising to drivers of Delco equipped cars.

More than 75,000 automobile owners are duplicating, day after day, in their own driving, the experiences of the Royal Automobile Club Committee.

DO YOU KNOW:—That the President of the United States has "ELECTRENE" Fire Extinguishers on his motor cars?

DO YOU KNOW:—That the

"ELECTRENE"

FIRE EXTINGUISHER

was awarded the GOLD MEDAL and DIPLOMA of MERIT at the INTERNATIONAL EXPOSITION of SAFETY and SANITATION, held in the Grand Central Palace, New York City, December 11-20, 1913?

DO YOU KNOW:—That the "ELECTRENE" Fire Extinguisher is STANDARD in the NEW YORK FIRE DEPARTMENT?

DO YOU KNOW—That the BROOKLYN RAPID TRANSIT CO. has placed One Thousand "ELECTRENE" Fire Extinguishers on its electric cars recently?

DO YOU KNOW—That the great hotels, the Waldorf-Astoria and the new Biltmore, have placed Three Hundred "ELECTRENE" Fire Extinguishers in their equipment?

THERE IS A REASON—IT IS THIS. Discriminating buyers who consider MERIT and believe in the "PROTECTION FIRST" policy—tell us that "ELECTRENE" is in a class by itself, when it comes to a question of Quality-efficiency and reliability.

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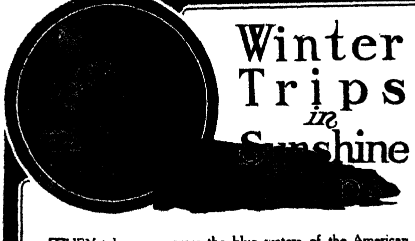
ELECTRENE COMPANY

WHITEHALL BUILDING NEW YORK CITY



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Notes for Inventors

Housing the Bed in the Ceiling.—Theodore H. Sorlein, Granite Falls, Minn., has secured a patent, No. 1,069,585, for a bed which when not in use can be moved up into an opening or recess in the ceiling and then a false ceiling plate can be moved to obscure the bed from view. The English novelist H. G. Wells some years ago suggested that bed-making could be simplified by hoisting the bedclothes on strings between ceiling and floor and by dropping them into position again when bedtime comes.

Three Patents Relating to Steel Production.—James Churchward of Mt. Vernon, N. Y., has secured three patents, one, No. 1,069,318, being for an optical pyrometer adapted to be used in measuring of glowing bodies and by which the temperature may be measured by direct observation of the glowing body, by passing the rays through a medium having an adjustable opacity and thereby eliminating all rays except those representing a certain shade whereby the temperature may be determined. A second patent, No. 1,069,387, relates to a steel process and an article, the process seeming to produce a fibrous structure in steel and compositions of steel. The third patent, No. 1,069,601, provides a rotatable furnace of special construction described as fitted to secure homogeneity in molten material and especially metallic mixtures.

A Number of Peter Cooper Hewitt Patents.—Peter Cooper Hewitt of New York, assignor to Cooper Hewitt Electric Company of Hoboken, has secured patents No. 1,064,685 for electric lighting apparatus, No. 1,064,686 for gas or vapor electric apparatus, No. 1,064,687 and No. 1,064,689 for vapor electric devices, No. 1,064,688 for electric lighting apparatus, No. 1,064,690 for automatic starting device for vapor lamps, and No. 1,064,691 for system of electrical distribution.

United States Patents to Foreigners.—hen we stop and consider the large number of patents of the United States issued to residents of foreign countries, we are surprised, and gratified that foreign residents appreciate the benefits and take advantage of the opportunity to secure patent protection in this country to such great extent. In a recent weekly issue of patents the total number of patents issued to residents of the United States was 442 while 95 patents were issued to residents of foreign countries, or more than twenty per cent of the number issued to residents.

Maturing Immature Cotton Bolls.—John Ellwood Lee of Conshohocken, Pa., assignor to John B. Hall of Philadelphia, has patented, No. 1,073,914, an apparatus for maturing immature, unopened or frost bitten cotton bolls, in which a moisture extracting chamber has an endless apron to receive the bolls and means for ejecting steam upon the bolls and for regulating the temperature of the moisture extracting chamber.

A High Combustible for Explosive Engines.—In a patent, No. 1,073,233, to Rudolf Hense, Charlottenburg, Germany, there is presented a process for obtaining a combustible of high value in which light hydrocarbons are added to heavy hydrocarbons and distilled at a high temperature and to the product caustic potash is mixed and the mixture settled. The settlement is then taken off and to the resulting mixture is added rosin substances as colophony and compounds of the nitro group as picric acid after which the mixture is settled, the liquid drawn off and purified and cleared by fractional distillation.

A Bookbinding and Covering Machine.—In patent No. 1,073,324 to Alfred Bredenberg of Champlain, N. Y., assignor of one half to the Sheridan Iron Works of New York and one-half to T. W. and C. B. Sheridan Co. of New York, is shown a bookbinding and covering machine having an endless carrier together with mechanisms for performing successively upon the book carried by the carrier various operations involved in binding and covering with such mechanisms arranged in series, part along one stretch and part along another stretch of the carrier.

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PATENTS

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Inquiry No. 9338. Wanted the name and address of patentees who desire to dispose of their patent rights in Silo Doors; also names of manufacturers of the same.

Inquiry No. 9339. Wanted names and addresses of purchasers of Uranium and Vanadium.

Inquiry No. 9340. Wanted the name and address of manufacturers of knock-down barrels, staves, hoops and heads which may readily be assembled.

Inquiry No. 9341. Wanted, mail order article. A man with long experience in the newspaper and advertising field desires to get in touch with the inventor or manufacturer of some quick-selling article, with the idea of inaugurating a Mail Order business to mutual profit.

Inquiry No. 9342. Wanted, a machine to cut No. 12 wire in 2½ inch lengths and sharpen both ends similar to tack points. One operation preferred.

Inquiry No. 9343. Wanted the name and address of manufacturers of machines for grinding the peel of oranges and grapefruit.

Inquiry No. 9344. Wanted name and address of manufacturers of patent articles of merit suitable for mail order distribution.

Inquiry No. 9345. Wanted name and address of manufacturers of Oxy-Acetylene Cutting and Welding Torch; also an easy opening can suitable for shoe polish.

Inquiry No. 9346. Wanted the name and address of [illegible] manufacturers, [illegible] and other machinery pertaining to cigar manufacturing and cigar banding machines.

Inquiry No. 9347. Wanted the name and address of an industrial school where [illegible] is taught in all its branches.

Inquiry No. 9348. Wanted the name and address of manufacturers having [illegible] with a view to obtaining exclusive territory for a house to house canvass.

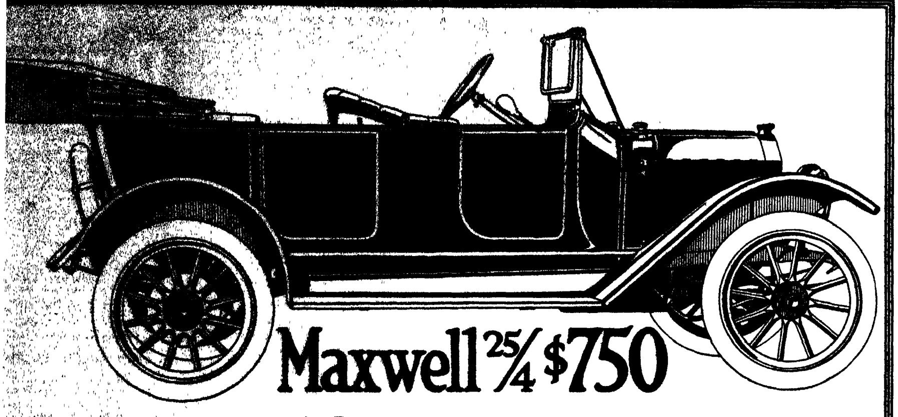
Inquiry No. 9349. Wanted the names and addresses of the makers of machinery for making [illegible] Tonic, also a machine for [illegible] and machines for applying [illegible].

Inquiry No. 9350. [illegible]

Inquiry No. 9351. [illegible]

Inquiry No. 9352. [illegible]

[illegible]



Maxwell 25/4 $750

The Pioneer of the Past—and of the Future

The Oldest, and yet the newest car in this Automobile Show is the Maxwell "25."

No name dates farther back in this industry—and yet if you look where the crowd blocks the aisle, you'll agree that visitors consider the latest Maxwell—the "25-4"—the newest of them all.

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It is Revolutionary.

Revolutionary, because never before has it been possible to obtain a car of such size, such capacity, such power, such performance and of such quality throughout, as you will see in this Maxwell "25" at the price—$750 fully equipped.

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Good Lubrication

(Concluded from page 74.)

not only necessary that the compression should be secured, but that it should be secured by proper means.

The troubles attendant upon poor compression in the cylinder are well known to most motorists. Under these conditions a motor is frequently unable to take a hill at all, and in any case the speeds must be changed in order to accomplish it. This is the case even where the same motor with good compression will not have the slightest difficulty in negotiating the same grade at top speed.

Good Adhesion Necessary in an Oil.

It is, therefore, evident that in order to maintain the good compression in the cylinder and at the same time avoid excessive wear and tear, due to metal to metal contact, it is necessary to have an oil which will adhere to the cylinder walls, filling the space between the piston rings and cylinder walls so that compression is secured and the metal surfaces are still kept apart. If the lubricating oil used is too light or is not of such a character as will provide this, the piston rings and the walls of the cylinder will come together so that there is excessive wear, resulting in a larger clearance at some points in the cylinder, in a difficulty in securing as much compression as ought to be secured, and in a much more rapid replacement of parts in order to maintain a working condition at all

It is, of course, possible to run a motor for a certain length of time on any kind of lubricating oil, and it may be months before the difference in lubricating oil will begin to show itself. Unfortunately, however, when the difficulty becomes obvious the damage is practically all done.

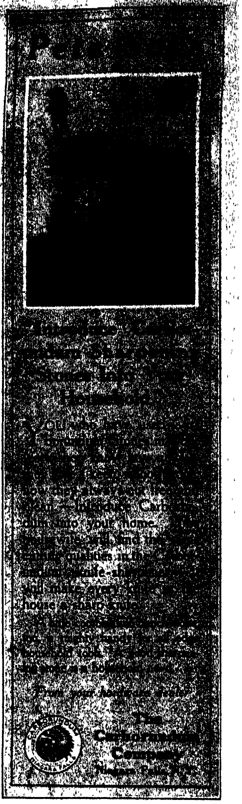
In this connection it may be stated that, while the different motors have different systems of lubrication to some extent, and while these different systems may require slightly different grades of oil, this is not true of all oils or of all the modifications of the systems. Practically all systems of lubrication in use can be divided into three general classes and combinations of these classes. They are—splash, force feed, and circulation systems—and the difference in the oil required for these different conditions of lubricating systems is merely a difference in body, due to the mechanical limitations and not a difference in character. It is true that some of the oils on the market are so manufactured as to be suitable only for a limited number of conditions, and in such cases variations in motor and lubricating system design may require modifications in the character of the lubricant.

It is probable, however, that there are more grades of lubricating oil in use than the mechanical conditions would warrant, and the right character of oil is much more important than a specific grade.

Changing the Oil in the Crank Case.

For all systems of lubrication, and particularly with the splash system and the modifications thereof, it is very important to see that the lubricating oil in the crank case is changed a sufficient number of times, particularly if there is any leakage of the air mixture into the crank case during the compression stroke. It frequently happens that there is a slight leakage on each compression stroke sufficient to allow a certain amount of gasoline to get into the crank case, where it condenses in the lubricating oil, making the oil absolutely unfit for further use, and increasing the cylinder wear-and-tear out of all reason. Motors have frequently been run for 200 or 300 miles with lubricating oil in the crank case which was absolutely useless, as far as preventing wear-and-tear was concerned, and which performed its only service in carrying away some of the frictional heat so that there was no freezing of the engine.

In one case which came to the writer's notice, after the car had been standing for some time, a repair man opened the crank case, lighting a match in order to examine something inside the case, was surprised at an explosion sufficient to seriously burn his hands and face. This explosion was undoubtedly due to the presence of gaso-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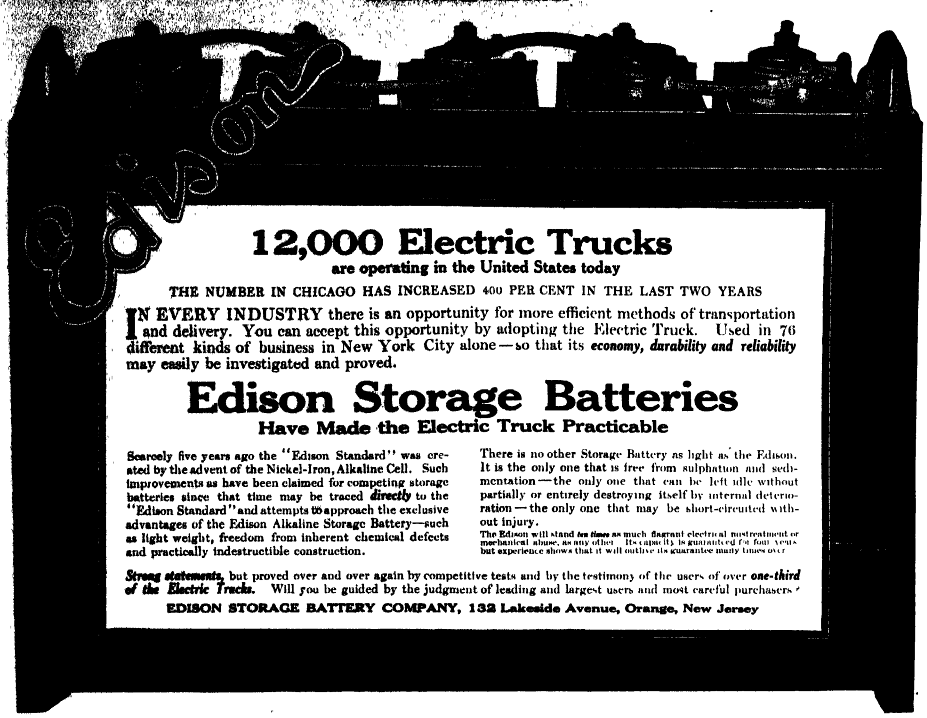

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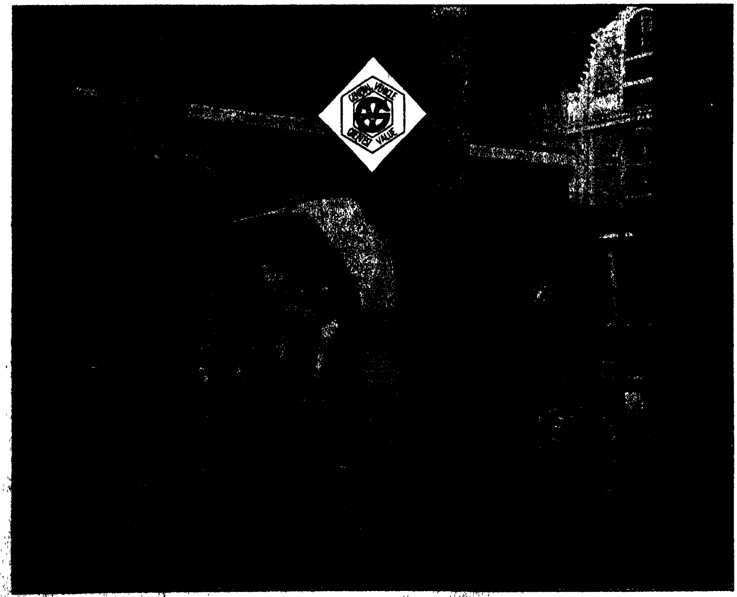

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line in the lubricating oil in sufficient quantity and its evaporation into the surrounding atmosphere.

It is evident from a careful study of motor lubrication that the character of the lubricating oil and system not only have a direct bearing upon the wear and tear, but also upon the power developed and the consumption of the lubricating oil, and of these it is probable that the difference in power developed is alone sufficient to more than pay for any difference there may be in oil cost. It is, of course, obviously impossible for any man in the ordinary running of his car to test as thoroughly as advisable the effect of a lubricating oil. It is true that the effect of the oil in practical work on the road is the important effect, and if the motorist is given to careful and accurate recording, he can by cleaning his machine thoroughly, by putting in an exact quantity of oil, by running over a specified course, using a certain speed or gear change on the hills, seeing that the atmospheric conditions are as nearly as possible alike, and using the same gasoline in both cases, determine the effect of his lubricating oil closely and accurately. If he keeps his accounts fairly well and understands how much it costs for repairs and replacement to his car, he can determine without such testing whether there is any difference in the use of one oil over another, particularly in the replacements of spark plugs, regrinding of valves, and in the cleaning of cylinders, but in this case he obviously must cover a great deal longer time, and his decision will be correspondingly delayed.

As a matter of fact, the only feasible way for the motor owner to do in determining the value of different oils, is to confine his buying in the first place to one or other of the several well-known brands of oil which have, what the lawyer would term, *prima facia* evidence of their value and then by keeping an accurate account of the power developed, of the consumption of oil, of the deterioration of oil in his crank case, of the carbon deposited on valves and spark plugs, determine the *oil which is best suited* (from the results it gives) to his machine and after such careful determination stick to the material which has shown itself to be the most adaptable and the best.

The Importance of a Clean Lubricating System.

The oil, however, is not to blame for all the misfortunes that happen to his motor, nor is the owner absolved from his duties when he has bought an oil which he has every reason to believe is good for his machine. Some care is required in attending to the lubricating system so that the proper amount of oil, without dirt, is fed to the moving parts. In the splash system or in modifications of it, where the oil is carried from the crank case and returned without filtering, it is important that the crank case should be cleaned frequently, as the constant dipping of the connecting rods into the oil will keep any particles of grit, suspended through the liquid so that they are carried into the moving parts of the motor with a very speedy damage to such parts.

Furthermore, if the oil in passing through the system and back to the crank case tank is filtered, the filtering material should be removed and replaced frequently enough to insure its working at all times. The pipes which carry the oil to the various parts of the machine should be examined from time to time to see that they are clear and clean, and particularly in the winter time (unless the oil is of such a character that it will withstand practically any ordinary temperature without congealing), care should be taken that the pipes do not become clogged with congealed oil when the motor is standing.

The question of lubricant, or the transmissions and differentials, the magneto, etc., as well as grease for the axle bearings, etc., is of just as much importance as the lubrication for the motor itself. The difficulty of determining the effect of such lubricant is in this case, however, increased so that it is practically impossible for the motorist to determine as between a number of fairly good lubricants which are the best and most advantageous, and there is only one safe rule in this case, and that is, to buy the lubricant from the manufacturers who are supplying the motor owner with the most suitable cylinder lubricating oil.

Nothing gives less indication of its practical efficiency as lubricating oil. Color is not indicative, as two oils can be practically the same color and produce entirely different results from the standpoint of saving wear and tear, replacement and repair cost. Even the character of the crude has little bearing upon the value of the oil itself, and the only oil which is worth the motor owner's attention is the oil which proves in your machine that it will keep down the replacement of sparks plugs, regrinding of valves, cleaning of the cylinders, keep up the power, eliminate as far as possible deterioration in the crank case due to leakage from the cylinders. These are indications of its value which cannot be mistaken and which do not depend upon hypothetical determinations or tests the value of which the motor owner has no means of judging.

Adaptability of the Motor Truck

(Concluded from page 12.)

While the first of these, translated into its motor truck equivalent, is important, the second is absolutely vital, because here is where the big loss in operation most frequently takes place. Working a motor truck to its true capacity is a dark mystery yet to the average owner—and chiefly because he lacks the data on which to base his system.

Accurate recording instruments, giving mileage and periods of travel and idleness, are as vital to the truck as gasoline and oil if it is to be properly used.

The remaining principles, when they are applied to the truck, become a part of the second, in that they contribute to securing the maximum of productive activity.

The manufacturer must get materials promptly to the lathe and remove its product quickly. So must the motor truck be loaded and unloaded in the shortest possible time. And it will pay in the long run to remodel shipping rooms and loading platforms, install conveyors or interchangeable or dumping bodies as required, or, if necessary, to increase the loading crews. Idle time at several dollars an hour will quickly eat up the worth of the improvements. It is paying executives to tour the country with their architects, to study loading conditions and to build to keep pace with the revolution caused by new transportation methods.

As in the case of all other productive machinery, the operator must be skillful. Bonus systems, schooling, accurate impersonal and impartial supervisions, and high wages to good men will pay dividends in the delivery department. An expert repair man, or, failing that, a driver who has an incentive to show an efficiency record and the means of showing his efficiency conclusively by reason of the accuracy of the owner's knowledge of the truck's work, can save his salary many times over by a daily inspection and tuning up. Reckless maintenance promises of the salesmen have made the buyer indifferent to his own responsibilities. The lathe is not expected to be abused and repaired by the maker; neither should the motor truck.

To establish such ideals of efficiency as these calls for co-operation, education, and a revision of standards on the part of everyone connected with the problem. When the size of the industry is considered, it is clear that the successful solution will affect the well-being of the entire community by lessening the increasing cost of the distribution of commodities.

Wright Automatic Stabilizer for Aeroplanes

(Concluded from page 17.)

izing plane, but a series of small ones, strung out over the whole lateral extent of the aeroplane. It is a defect of design in the device shown that the moving parts are too self-supporting, so that they are heavy and inert, whereas they could every-

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But—a few car manufacturers give you the sort of bearings that cost them the least money, and attempt to sell you their car on the strength of some good self-starter, because they have an idea that this good self-starter is going to make you think that the CAR ITSELF must therefore be good.

The self-starter isn't going to keep your car out of the REPAIR-SHOP, nor is the lighting system, nor is the speedometer, nor is the top, nor is the twelve-inch upholstering nor any of the other necessary, but decidedly MINOR features which they attempt to blind you with.

If you want your car ON THE ROAD, if you want it to cost you little to RUN, go deeper than the mere starting of it. Go right down to the vitals—the BEARINGS—the little parts that take the WEAR and therefore determine the LIFE of the car.

The manufacturers of the better cars in the low-price field, as well as those in the medium and high-price fields, give you bearings and bushings of—

NON-GRAN

And They TELL You So

Manufacturers who skimp on these little bearing parts (which are way inside the mechanism of the car and which you can't see) say NOTHING about their bearings, and draw your attention right up to the self-starter and the beautiful lamps.

To REPLACE a worn bearing (and a worn bearing MUST be replaced) will cost you anywhere from $25 to $200, depending upon how much labor is necessary in tearing down to REACH the bearing.

It's better to pin your man down BEFORE you buy, and judge a car by its VITALS rather than by its ACCESSORIES—important as these accessories may be.

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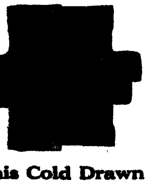

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where be supported on stationary parts, and then be broken up into a multiplicity of small units of far less total inertia and proportionally greater strength. Restrained by the "stops" at 9, the plane 5 must be made almost impractically heavy, so as not to be warped out of shape or broken by the wind. A great number of smaller planes would also make the average air pressure on the stabilizer almost identical with that on the main aeroplanes and do away with the difficulty previously pointed out. The many small "parallel motion" frames would then have to pivot on a common shaft.

It remains still to be pointed out that the front elevator shown is less suited to automatic control than the rear horizontal rudder which will doubtless be actually used. If the front rudder is swung suddenly, it may easily get the machine into a situation where its reversal produces no further effect. It will quickly turn it around its transverse axis, with the weight concentrated along that line, but the relative wind will not change accordingly. The machine will "coast," first moving on in the old direction because of its momentum. This will increase the effect of a front elevator; the machine will "buck" so violently, that the reversed rudder will become merely parallel to the relative wind, and a tail slide will be inevitable.

If there is a minimum of "internal work of the wind," the device shown may work well and, safeguarded by the hand control 10, prove a labor-saving device like the pendulum. By an ingenious arrangement the parallel motion may be so adjusted during flight by pushing out or pulling in the handle 11 (held in place by friction) that the plane 5 will then keep the main planes at an ascending or descending angle of attack and thus stabilize a long *vol plané* or a climb just as well as horizontal flight.

During a recent visit of Mr. Orville Wright to New York, it developed that the actual stabilizer used exhibits essential differences from the patented device, although it may be said to work by the same principle. It was revealed that electrical contacts play a part in transmitting impulses which would be greatly in favor of a graded effect, that an entirely novel correcting device counteracts inherent deficiencies of pendulum control, and that the horizontal rudder is indeed in the rear; also, especially, that the weights are now in every direction concentrated as much as feasible at one point, to guard against inertia and momentum effects. Thus modified the apparatus is stated to have worked successfully in long daily flights even in winds of from twenty to twenty-five miles an hour. Changes merely in the angle of the relative wind may apparently be coped with by stabilizers of the Moreau or the perfected Wright type. The fact that the automatic mechanism has proved serviceable in winds of twenty to twenty-five miles an hour, is not astonishing if the wind was uniform or if such variations as were manifest were confined to a change in direction only. The difficulties to be most feared are those which accompany violent changes in the strength of the wind. It also was found necessary to cut out the automatic control in landing.

Mr. Wright is certainly better equipped in every way to develop such a difficult mechanism than most others, and if it should work half as well under critical conditions, as it is said to under normal conditions, its publication on the tenth anniversary may prove to be fully as important as the first announcement of the aeroplane itself. It was stated that barely a touch of a lever for steering was all that was needed.

A Record Balloon Voyage

A DISPATCH from Perm, on the border between European and Asiatic Russia, announced the arrival on December 21st of a German balloon which made the flight of 1,740 miles from Bitterfeld, Prussian Saxony, without a stop in eighty-seven hours. This beats the record of the French aeronaut, Bienaime, who made a

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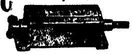

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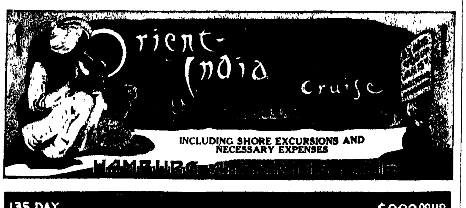
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We can name no writer better qualified to prepare a book of instructions on automobiles than Mr. Victor W Pagé His experience for years as technical editor of a motor-car journal taught him what the public wished to know, while his training as instructor in automobile schools showed him how to impart this information to others in simple language. His previous works, "The Modern Gasoline Automobile" and the "Trouble Chart," by which the location of gasoline engine troubles was made easy, are widely known among automobilists Soon after their publication many letters were received asking the author to prepare a more elementary work which could be sold at a lower price The present work is an answer to these petitions It is written in the form of a catechism, beginning with the very rudiments of automobile engineering, and presupposing no previous technical knowledge on the subject Not only pleasure vehicles but commercial vehicles, as well, are included in the work Special care is taken with the logical arrangement of the various topics There are about two thousand questions and answers which take up in a practical way every detail of the machine with which the owner is liable to be concerned It is written for that vast army of motorists who cannot afford to hire a chauffeur and must take care of their own machines It is written, as well, for the man who can afford to pay for the care of his motor car but is not willing to be imposed upon by a dishonest chauffeur working in collusion with unscrupulous repair-men The book is copiously illustrated with drawings and photographs, showing the latest domestic and foreign practice.

AMERICAN TELEGRAPH PRACTICE. A Complete Technical Course in Modern Telegraphy, including Simultaneous Telegraphy and Telephony By Donald McNicol, A M, A I.E E. New York. McGraw-Hill Book Company, 1913 8vo, 507 pp, illustrated Price, $4 net.

American systems are handling a hundred telegrams to-day where ten years ago they could take care of but fifty and the time of transmission between distant points has been cut in half The work in hand conveys a clear idea of the way in which this development has been brought about Existing systems and modern methods of operation are described and the mathematical formulæ are so worked out as to be readily mastered by all who understand arithmetic and elementary algebra

THE NATURAL HISTORY OF THE TORONTO REGION Ontario, Canada Edited by J H Faull, B A., Ph.D, Associate Professor of Botany, University of Toronto Toronto. The Canadian Institute, 1913. 8vo.; 419 pp; with maps and illustrations. Price, $2.

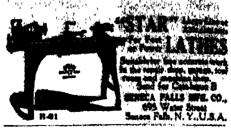
The articles comprising this work are the authoritative utterences of specialists, and well worth the study of any who may have an interest in the natural history of the city and its vicinity History geology, and climate are touched upon, and the flora and fauna are described in a series of papers that present their respective subjects in a well-arranged and accurate manner The work is rich in maps no less than three being carried in a back pocket of the book while others appear as folding inserts or full-page charts These graphically present such subjects as the life zones of eastern North America a road map of Toronto and environs and maps of neighboring countries

THE HEART OF GASPÉ Sketches in the Gulf of St Lawrence By John Mason Clarke New York The Macmillan Company, 1913 8vo, 292 pp.; illustrated Price, $2 net

Gaspé, whether regarded as a county or a peninsula is the northeastern outpost of Quebec It is larger than Massachusetts, its wild coasts sparingly dotted with villages, whose settings, modes and customs are survivals of remote ages The author characterizes the inhabitants as invariably kind and hospitable, wresting their scanty livings from reluctant soil and sea His pen-pictures of their rough yet fascinating country are enhanced by glimpses of history and information regarding its place names Many illustrations of natural scenery, native architecture, and seabirds and their haunts enliven the pages of a narrative that without any attempt at fine writing, yet conveys with a simple fidelity the rugged charms of a territory whose features will be new to many readers

ON HEROES, HERO-WORSHIP, AND THE HEROIC IN HISTORY. By Thomas Carlyle. Edited, with Introduction, Notes, and Bibliography, by Herbert S. Murch, Ph.D., Instructor in English in Princeton University. New York: D. C. Heath & Co., 1913. 12mo.; 313 pp.

This new edition of Carlyle's inspiring and illuminating work has been prepared by Prof Murch with particular care toward the needs and limitations of those just entering upon the study of Carlyle The biographical introduction is immediately followed by a discussion of the style, plan and teachings of the work, in which certain difficulties are explained away, and the student is enabled to approach the lectures in an understanding manner. The profuse notes are a further aid toward clarifying the text to the beginner's mind, and a bibliography for supplementary reading will prove to be an appreciated feature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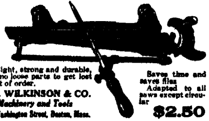

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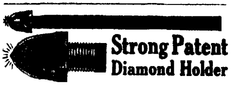

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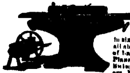

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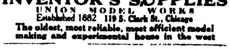

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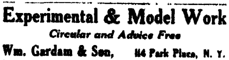

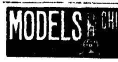
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(12888) C. S. is informed that no inquiries are answered unless the full name and address is given. We do not make any broad statements as to who make "best" revolvers, etc. The concern you mention by name makes a reliable article.

(12889) C. U. asks: Kindly tell me what is the scientific reason for the effect which oil has when poured on tempestuous waves. A The spreading of oil over the surface of water is due to the fact that the surface tension of the oil is less than that of water. The water draws the oil over its surface by reason of its greater surface tension The oil on the other hand has a very great viscosity, and the film of oil on the water holds the surface of the water from breaking into ripples. The waves therefore become smooth, and although they are still very high, they roll smoothly by and do not break over the vessel. The vessel rises easily and rides over the waves, which without the oil broke over the vessel.

(12890) J. W. McC. asks: I am anxious to get in touch with some schools that have divided or rather segregated the boys and girls in the physics work. We are doing the work on this line this year, but have not been able to find a suitable text for the girls. This is what I am after Any information will be appreciated. A We do not know any schools in which the *girls* are taught physics in classes separated from the boys. Physics is usually taught as a branch of mathematics in high schools and most colleges, and the subject is divested of most of its interest for young people for this reason. A text book based upon the experiment and not upon the formula is much to be desired. One appeared this year which is very attractively gotten up, by Millikan and Gale, which we send for $1 40 postpaid It is called "A First Course in Physics," and is almost wholly descriptive. No similar college text book has appeared.

(12891) J. W. B. asks: As I have not missed a number of the SCIENTIFIC AMERICAN in forty years, I now for the first time ask a favor. I want to know what material is the best insulator to fill a 1¼-inch space between the inner and outer side of an ice box. Sawdus is not much good, and air space cannot be perfectly confined. A Charcoal has been used more than anything else in filling the walls of refrigerators, though wool should be just as good Anything which will prevent currents of air will answer the purpose, one thing is about as good as another. Sawdust will do this, and it is not a conductor of heat There is nothing which will act absolutely to prevent the passage of heat. A vacuum is the very best insulator against the passage of heat, but this is not practicable in an ordinary refrigerator

(12892) D. L P. asks: Please tell me how to make an amalgam with silver and mercury A In the preparation of silver amalgam, pure silver must be used If the silver is in the powdered form, the amalgamation is more easily brought about The silver powder can be prepared from a solution of nitrate of silver, one part in 10 to 15 parts of water Put this solution into a bottle and shake it with a few small pieces of sheet zinc The silver will be precipitated in a few minutes. When the powder has been washed and dried it is ready for use The silver can be dissolved directly in the mercury, but a quicker method is to heat the mercury nearly to its boiling point in a crucible, and add the powdered silver, stirring meanwhile vigorously with an iron rod Silver amalgam can be prepared in the cold by making a solution of nitrate of silver, 1 part of nitrate by weight to 3 parts of distilled water and adding 4 parts of mercury to this solution. The combination will take place by shaking the mixture This process is taken from the "Scientific American Cyclopedia of Formulas," price $5, which contains nine pages upon the formation and uses of amalgams.

(12893) L. G. B. asks: I find plenty of information in the Encyclopædia Britannica and elsewhere on the dynamics of real gases with elastic molecules How would the inelastic and frictionless particles of a hypothetical gas consisting of such particles behave? What directions would they take after collisions? Please refer me to literature discussing this. A. A frictionless, inelastic particle could not take any direction after collision with another similar particle. It could not rebound at all. It would lose all its momentum on collision and there would be no restitution for a rebound, since it is inelastic. We have no references to any literature of this subject Balls of lead are sufficiently inelastic to illustrate this. They do not rebound from each other after collision, as in the familiar experiment in physics

(12894) C. A. H. asks: A small tube closed at one end and filled with water will retain the water when held perpendicular with the open end down. This is due to atmospheric pressure. A claims that the same thing would happen in a pipe or tube of any larger dimension if the tube was held absolutely still. B claims that the water would fall if the diameter of the tube were larger. Which is correct—A or B? If B is correct, would like to know how large the diameter of the tube would have to be before atmospheric pressure would cease to retain the water therein. A. The tube closed at one end, filled with water and inverted, will retain the water if the diameter of the tube is small enough to be called capillary If larger than this, the water will run out The surface tension of water has a large part in the support of the water in the tube We cannot give the diameter of the largest tube which will support water in this manner, but we have seen it done with tubes as large as a tenth of an inch.

(12895) O. O F asks: Please insert an answer to the following questions in the Notes and Queries section of the SCIENTIFIC AMERICAN 1 What is the difference in feet between low tide and high tide on the ocean or on the Atlantic coast generally? A On the open ocean the difference of level between high and low water of the tides is 2 or 3 feet On the Atlantic coast it varies *from 2 to 3 feet up to 50 to 60 feet* 2. How far into Delaware Bay, Chesapeake Bay, and Long Island Sound does the tide reach with the same difference between low and high tide as on the ocean? What is the depth of these inlets at the mouth? Where can I buy a book containing similar information of any part of the world? A We have not this information, and do not know where it can be obtained in any single book The various books of sailing directions which navigators have for their voyages will give it for the different ports which they cover The United States charts of the coast will give the depth of water at all parts of the coast These books and charts can be purchased from dealers in nautical instruments. We would add that a high tide flows into Long Island Sound through New York Bay, and meets a low tide which enters the Sound from the east near Hell Gate, thus making the rough water and dangerous currents of that narrow passage and causing less rise and fall than if a single tide was in the Sound. Six hours later the tides are reversed, with the same result The same action takes place in many parts of the world around a large island. 3 Does a propeller, similar to those used on aeroplanes, with a given power, have as much pulling force as a vehicle with the same power applied to the wheels? If not, how much less? If air were forced out from the rear of a vehicle with great force, would the propelling force equal that of a propeller with the same power? *If the air were drawn in from the front,* with great rapidity, leaving a partial vacuum, would the propelling force equal that of a propeller? A A propeller working against a very mobile fluid like air does not have the same propelling force on a vehicle as when the same power is applied to the solid earth by the wheels Jet propulsion has been tried in water with no valuable results excepting the gaining of experience and, as Mr Edison once said about some unsuccessful experiments "learning what cannot be done" It does not seem to be possible to get the same power from a jet as from a propeller A vessel was built in recent years for jet propulsion with no success

(12896) W S E asks: Please tell me through your columns why you can cut glass under water with a scissors A We have not been able to cut glass under water with shears in such a way that both pieces can be used We can chip off the edges of a piece of glass under water The pieces cannot fly in the water as they do when one cuts them in the air, but the crack often extends in a direction different from the one in which you wish it to go and the piece is spoiled We should say that glass cannot be cut with any precision under water with a pair of shears The water seems to assist the shears in biting on the edge of the piece of glass, and to hold the pieces from flying about

(12897) E. P V. asks A asserts that the earth moves faster at the equator than at any other place B asserts that as the earth rotates as a whole, no one portion of it can move more swiftly than any other portion A asserts that the angular velocity is the same but that the linear velocity is greater at the equator than at any other point As you are doubtless familiar with the general trend of such discussions, the pros and cons of this particular one will not be repeated Which is right? A. The earth rotates with the same angular velocity in all latitudes. The relative linear velocity is therefore the same as the lengths of the degrees of longitude The degree of longitude at the equator is 69 16 statute miles in length. At your place it is 58 05 miles, in New York it is about 52.25 miles, and at the pole the degree has no length. So while the earth's surface moves 69 miles at the equator, it moves 58 miles at your place and 52 miles at New York. If you will take an orange or a lemon and turn it in your hand as the earth turns on its axis, you will doubtless see why this is the result in the earth.

(12898) W. H. S. asks: I shall be obliged to you if you will please give me the fusing temperatures (melting points) of the following metals: Platinum, iridium, gold, silver, copper, zinc, tin, lead, iron. A. We give you the melting points of the metals which you name in your inquiry, as given in the Bulletin of the Bureau of Standards No. 35, published by the United States Government, Washington, D. C. Platinum, 3,191 deg. Fahr.; iridium, 4,170 deg. Fahr.; gold, 1,945 5 deg. Fahr.; silver, 1,761 deg. Fahr; copper, 1,981.5 deg. Fahr.; zinc, 786.9 deg. Fahr., tin, 449.4 deg. Fahr.; lead, 621.1 deg. Fahr.; iron, 2,768 deg. Fahr.

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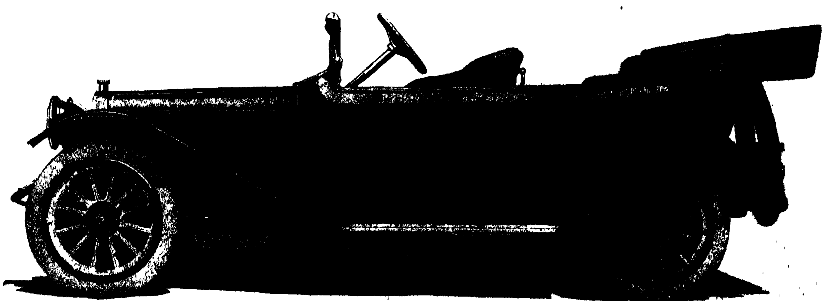

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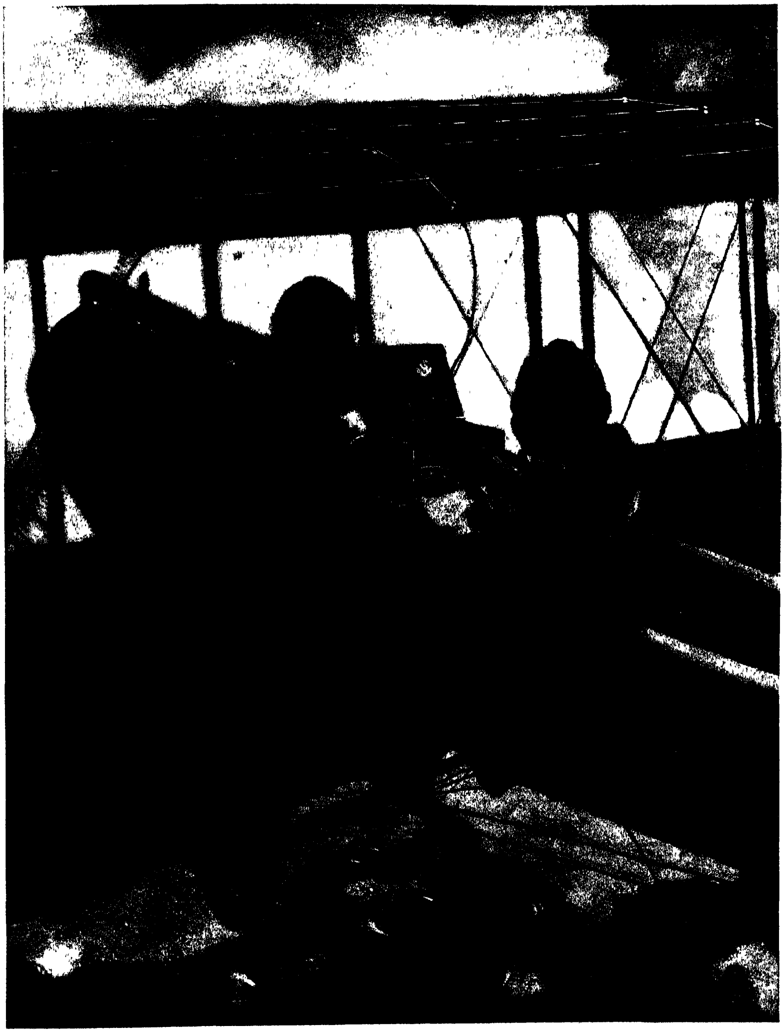

THE AIR SCOUT AND THE WIRELESS TELEGRAPH

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement

As to Alaska

IT is nearly half a century since we purchased Alaska. In the interim we have paid so little attention to this vast territory, the largest body of unused and neglected land in the United States—that it is inhabited by less than 40,000 white inhabitants—a gain of less than one thousand for each year since it passed beneath our flag. In the intervening forty-six years we have got from Alaska more than we have given; for it has repaid our inexcusable neglect by adding to our wealth through the yield of its mines, fisheries, and furs alone, more than $500,000,000.

To those who are interested in Alaska—and that should mean every citizen of this country—we commend the report of the Secretary of the Interior for the fiscal year ending June 30th, 1913, an illuminating document, well calculated to awaken a widespread national interest in this neglected country, and a sense of our national duty to provide for its intelligent and systematic development and government. The prospector has proved that no other section of our land makes so rich a mineral promise, and the Government has demonstrated that in agriculture, Alaska will produce in abundance everything that can be raised in the Scandinavian countries. It is estimated that there are in Alaska fifty million acres of land that will make homes for a people as sturdy as those of New England.

The Government has made a start by withdrawing Alaska from the too aggressive and self-serving exploiter, but, as yet, we have done nothing to substitute a safer servant of the public interests. If we are to bring Alaska into the early and full realization of her possibilities, we must create a new piece of governmental machinery for the purpose. Secretary Lane would establish a Board of Directors, and into its hands he would give all the national assets of that territory, to be used primarily for its improvement—its land, fisheries, Indians, Eskimos, seals, forests, mines, waterways, railroads, all in fact, that the nation owns, cares for, controls or regulates. This board would have nothing to do with the internal affairs of the territory, and it would exercise no powers save such as Congress might grant over the property of the United States in Alaska.

The arguments set forth by the Secretary in favor of the above policy are convincing. In the first place, such a board would advise Congress as to what should be done, without prejudice and out of a deep national interest and with first-hand knowledge of conditions. It would co-ordinate the present enterprises of the Government. As matters stand, the control of land is in one department, of forests in another, roads in another, of fisheries in a fourth, and of railroads in still another department. As a concrete instance of these conditions which strikes us as positively funny, we are told that the care of black bears is in one department and of brown bears in another. Every one will agree with the Secretary, surely, that there can be no satisfactory administration of land laws, nor indeed of any other laws, at a distance of 5,000 miles from the point of action. Truly, "the eye that sees the need should be near the voice that gives the order." Alaska's opening and improvement should be treated as one problem, and each step of its administration should be part of a general plan, of a unified and consecutive programme based on immediate knowledge and conditions. The opening of land and the building of railroads or wagon roads, for instance, should be part of one general scheme.

The Secretary believes that Alaska should be developed, so far as possible, out of her own revenues and resources, that she shall have a federal budget of her own, her revenues and expenditures being presented to Congress on a single sheet. The funds raised from her lands and fisheries, her furs, her forests and her mines, should be used for the construction of her roads, railroads, telegraph and telephone lines, or for any other purpose which would make her resources more quickly available to the world. It is believed that Alaska is self supporting to-day. That is to say, that by proper taxes and charges imposed upon those who are deriving large returns from their enterprises in the territory, such revenues could be derived as would support a large policy of expansion and improvement.

Positive and Negative Natural Laws

THERE is something satisfying about a positive statement. To be told, for example, that the gravitational attraction between two portions of matter is equal to a certain known constant multiplied by the product of their masses and divided by the square of the distance between them, is to be given full and sufficient information to determine the gravitational pull between any two portions of matter whose masses and distance apart are given. Here the law is given in the form of an *equation*, which can be solved without ambiguity for any given case.

But not all laws of nature are of this positive type. We are still living in the age of the "heat engine"—our prime movers deriving their power in the great majority of cases from coal, oil or other fuel. Now the performance of which a heat engine is capable is *limited* by a law of physics—a negative law, for it tells us only what a heat engine can *not* do, it does not predicate anything positive about the performance of such an engine. A condensing heat engine dependent upon a source of heat (e. g., a boiler) at 380 deg. Fahr. and performing the coolest part of its cycle at say 100 deg. Fahr., can not possibly have a thermodynamic efficiency greater than 33 per cent. For the second law of thermodynamics tells us that the efficiency of any *real* heat engine, working between two absolute temperatures T_2 and T_1 is less than $(T_2 - T_1) / T_2$. This law, unlike that of gravitation, is expressed by an *inequality*, for which there are necessarily an infinite number of solutions, thus leaving room for ambiguity.

Now it might at first sight appear that such a negative law would be of little practical value. But this is far from being the case, if only because it serves as a warning to us not to divert our inventive energies into fruitless channels. Any attempt to build a heat engine with an efficiency higher than the limit set by the law quoted, represents so much labor wasted—at least so long as we can not deal with individual molecules. This has sometimes been expressed by saying that "perpetual motion of the second kind" is impossible: Thus for example, without any violation of the law of conservation of energy, we might suppose that a vessel traveling on the ocean might derive heat from the practically unlimited source provided for it in the ocean, turn this heat into work for propulsion of the vessel through the water, and at the same time return it to the sea by the friction of the ship's hull against the water. The sea would lose none of its heat, since what was taken from it for the ship's motors would presently be returned to it by friction. Therefore, it would seem, this process might be continued indefinitely. But such "perpetual motion of the second kind" is impossible—the law stated above bars all possible avenues to it.

So far, in fact, from useless are negative laws of nature, that this form is sometimes given to laws which are capable of being stated in the positive form. Thus the first law of thermo-dynamics, the law of conservation of energy, is sometimes stated to the effect that "perpetual motion of the first kind" is impossible—that energy can not be extracted indefinitely from a system which does not undergo some compensating change in the process, but returns at the end of the operation in every respect to its initial state. The value of this negative statement, again, is that it deters the cautious inventor from wasting his efforts in a fruitless quest. We say the *cautious* inventor, who takes the pains to inform himself of the knowledge acquired by others before launching out upon original work. Unfortunately there is never wanting an army of "inventors" lacking this caution, hence the daily growing literature on "perpetual motion" devices.

Limiting Motor Trucks to Preserve the Roads

IN Maryland, and probably in New York and several other States, at this winter's sessions of the legislatures, efforts are to be made to enact measures intended to preserve the public roads and bridges by restricting the weight and speed of motor trucks, traction engines and other vehicles.

Bills of this nature were passed last spring in Massachusetts, New Jersey, and Pennsylvania, and this fall the Commissioners of Highways of New York State issued a set of regulations based on the Massachusetts law. The Bay State and the Empire State regulations limit the gross weight of vehicles with load to fourteen tons, and the weight on any one wheel to 800 pounds per inch of nominal width of tire. They also limit to fifteen miles per hour the speed of vehicles weighing more than four tons with load, and to twelve miles an hour vehicles weighing more than six tons if fitted with rubber tires, or to six miles an hour if fitted with iron or steel tires.

Leading motor-truck manufacturers concede that these limitations are reasonable and are not opposed to them so long as they are enforced equally against all kinds of vehicles and objects moved over the roads. As a matter of fact, there are very few motor trucks in existence that have a rated capacity of more than five tons and which weigh, with full load, more than ten tons. Out of approximately 80,000 commercial vehicles now registered in the United States, less than 400 will weigh as much as fourteen tons with full load, and these are used mostly in large cities where pavements are strong enough to support them. Only a little more than 1,200 out of the 80,000 are of more than five tons rated capacity; for it has not been demonstrated satisfactorily that the larger sizes are economical of operation, at least when fitted with rubber tires. These figures, which are authentic, make it appear that the advocates of weight restrictions are needlessly apprehensive, so far as motor trucks are concerned.

Speed and narrow iron tires on heavily-loaded wagons are more destructive of roads than mere weight, especially when this weight is carried on wide rubber tires. All leading tire manufacturers recommend loads considerably less than 800 pounds to the inch of width for their tires and seek to discourage loading them beyond the specified weights.

The speed limitations of the Massachusetts and New York regulations are not objected to by the motor truck manufacturers, who have striven long and earnestly to discourage overspeeding as well as overloading of trucks. The automobile manufacturers' national association, the Automobile Chamber of Commerce, has adopted standard truck speed ratings that are slightly below the limits fixed by the State regulations, and the standard form of warranty issued with the sale of each truck provides that overspeeding and overloading will void the warranty.

Nevertheless, the manufacturers believe that legislation directed specifically at motor trucks is unnecessary, and that it will have a tendency to postpone the building of permanent roads suited to motor traffic and the rebuilding and strengthening of antiquated bridges of which too many remain. They object to the implication which such legislation carries with it, that the motor vehicle is the only type of vehicle that damages the roads; whereas the highway commissioners and engineers who are advocating these measures never have brought forward any record of scientific observations to show the actual kind and amount of damages done, and they themselves admit that heavy teams are one of the most injurious factors in highway traffic.

Yet owners of automobiles and motor trucks are the only persons who are required to pay a specified tax for the use of the roads; and this is one of the reasons why the motor interests oppose this form of double taxation and discrimination. They are heartily in favor of good roads, but they object to having the funds raised by taxation of motor vehicles applied to building and maintaining types of roads unsuited to motor traffic—particularly when it is through their efforts that large road appropriations have been secured from State legislatures.

Any laws that are passed to regulate motor trucks should be made uniform with those now existing in the largest and most important States. An attempt is now being made by special commissions, appointed by eleven Eastern States, to harmonize the differences that exist between the present motor vehicle laws and to recommend one uniform law for all. Nothing done at this winter's sessions of the legislatures should be allowed to make this task more difficult. It would be better to defer legislation than to create new laws or provisions that might have to undergo radical changes within a year, if the uniform law recommended by the joint commission should be adopted.

Volcanic Eruption in the New Hebrides

THE volcanic island of Ambrym, in the New Hebrides, was recently the scene of one of the most violent eruptions in its history. British and French officials, who visited the scene in the French cruiser "Kersaint," found the western coast of the island, between Dip Point and Banlaw, covered with ashes and scoria, which had fallen continuously for five days, while vast streams of lava had overwhelmed the Presbyterian mission hospital, French and English trading stations, cocoanut groves, etc., but no loss of life was reported among the few European residents. Most of the natives have been transported to another island. Many hundred natives are believed to have perished.

Engineering

Wash Your Smoke.—The New York Edison Company has perfected an apparatus for eliminating the smoke and cinder nuisance at its great Waterside station, New York. The smoke from the boiler plant, laden with soot and cinders, is driven at high speed through a sheet of water, by means of which practically all of the material which constitutes a nuisance is deposited in a big water tank. The recent test showed an average efficiency of extraction of 95 per cent.

Germany's New Gun.—According to the *Army and Navy Journal*, the new gun mounted on the "Ersatz Wörth" and battleship "T" is a Krupp 15-inch piece, presumably 45 calibers in length, which weighs 75 tons and fires a projectile of 1,667 pounds with a charge of 331 pounds of smokeless powder, at an initial velocity of 2,789-foot seconds, and with the resulting enormous muzzle energy of 90,880-foot tons. The possession of such a gun means the ability to hit hard and accurately at very extreme ranges.

A Larger Navy for Defense.—Representative Hobson, in explaining to the House why he considered that the United States was only a third-rate power, referred to the fact that our present small navy, merely in the performance of its police duties, would have to guard 30,000,000 people and 37 billion dollars' worth of property that were concentrated along our seaboard and actually within gunshot of a hostile fleet. He stated that America has more lives and property exposed to such attack than has all the rest of the world combined.

The "Aquitania's" Engines.—The new Cunard liner "Aquitania," which is due in this port early in the coming year, will possess the largest turbine engines ever built. They will weigh 1,400 tons, and they will contain over 1,000,000 blades, varying from 1½ to 20 inches in length. The engines will contain high, intermediate, and low pressure turbines, and will be marked by other improvements suggested by the extensive experience gained by this company with the turbine-driven "Carmania," "Lusitania" and "Mauretania."

Small Navy Yards Should be Abolished.—We are glad to note that the present Secretary of the Navy has stated that it will be his policy to reduce expenditures ashore and use the money so saved for increasing the navy afloat. Rear Admiral Wainwright, who is a strong advocate of building four battleships this year, states that, if the Government would see fit to do away with the small navy yards and increase the capacity of the larger ones, much of the annual expenditure could be used in other directions. In no direction could the money so saved be used to better advantage than increasing the appropriations for new ships.

Lifeboats and Davits.—The International Committee sitting in London has recommended that lifeboats be provided for all on board. If this recommendation be widely accepted, we hope that the future type of lifeboat and davit will be modified to meet modern conditions. Both the lifeboats and the handling gear should be greatly increased in size, accommodation and speed of control. The lifeboat of the type used on the "Titanic" was wofully out of date. Thirty-ton motor-propelled boats, capable of accommodating 250 people, and handled by powerful electrically-operated davits, should constitute the equipment of the large passenger steamer of the present day.

Non-magnetic Rails and Track-signaling.—According to our contemporary *The Engineer*, in order to accommodate the increasing use of track and signaling circuits on railways, with the necessity for bonding joints, points, and crossings, and separating rail sections to form the desired electric circuits, it is proposed by a German engineer to use non-magnetic rails. The non-magnetic track rails are made of nickel steel containing about 18 to 20 per cent of nickel, and they are inserted at desired points in the ordinary magnetic track for controlling signals, brakes, etc., from the vehicles. For light railways, the whole of the track may be formed from these rails, which do not affect the action of the weak electric current used in controlling the railway.

The Transatlantic Record.—The present transatlantic record is four days, ten hours from the coast of Ireland to the entrance to Ambrose Channel, New York. It was made by the "Mauretania." The "Lusitania," on her last westward passage, in spite of strong winds and head seas for the whole voyage, crossed in four days, eighteen hours, five minutes. This performance gives promise of the "Lusitania's" surpassing the record of her sister ship under favorable weather conditions, for during the above-mentioned trip, for a period of eight hours, she made 197 revolutions and averaged 27 knots, and for one hour of this time her revolutions reached 207, the equivalent speed for which would be nearly 28 knots. It is likely that during the coming year the record average speed across the Atlantic of 26.06 knots will be considerably exceeded.

Electricity

Electric Blasting to Prevent Tuberculosis.—The gold mining companies of the Rand field, South Africa, have been experimenting with electric blasting with a view to reducing the danger of miner's phthisis, a disease which is very widespread in that region, and is laid to the fine dust resulting from blasting. By using electric systems the firing can be done from the surface and the air can be cleared of the fine dust before the miners need to enter the mine.

Experiments in Electroculture carried on by the U. S. Bureau of Plant Industry during the past year have not had encouraging results. Electrically treated plats of wheat gave an increased yield of only one half bushel per acre above that of the check plats. In 1912 an increase of two bushels per acre was obtained. None of the experiments conducted by the Bureau has so far indicated that electroculture is practicable from a commercial standpoint.

Electricity Supply in London.—Considerable agitation has been stirred up in London, following the address delivered before the Institution of Electrical Engineers by Prof. G. Klingenberg, Ph.D., on the subject of electricity supply in large cities. He compared conditions in Berlin, Chicago and London, showing that in the first two cities only six power stations are used in each city, whereas in London there are 64, and he showed how much more economical it would be to employ a few large stations. He suggested the substitution of a large power station for 25 of the existing stations.

A Wireless Weather Service on the North and Baltic Seas, under German auspices, has been in operation since the first of last July. The radiotelegraphic stations at Borkum, Heligoland, Norddeich, Cuxhaven, Bülk, Swinemünde and Danzig are regularly supplied by the Deutsche Seewarte, at Hamburg, with telegraphic information enabling them to advise vessels at sea, on request, of the current barometric conditions over Europe and the winds likely to prevail over the North Sea, the Western Baltic or the Eastern Baltic, according to which of these regions is specified in the inquiry.

Magic Wand.—A curious magic wand has been developed in France. It is worked by the action of a concealed magnet, so that a mouse or other small animal appears to run up and down the wand in a mysterious way. The wand is a square tube of light wood covered with silk, and the animal is of celluloid and has a small piece of iron on the bottom. Inside the rod is a small lead weight on an endless cord, and when the wand is turned up, the weight falls gradually and draws along a small magnet, also fixed on the cord and just below the surface. When the rod is inclined, the rat thus climbs up to the top, and this can be repeated as often as one may wish.

Electrically Operated Moving Targets.—Moving targets are used in Germany which are mounted on trucks and drawn along the ground by the use of electrically worked cables and drums, so as to approach real conditions. In the electric plant is a large motor driving a number of drums, one for each cable and its target, the speed varying as desired. Silhouettes representing infantry are drawn along, at first slowly, and when fired at they run at a rapid rate till they reach the first trench, stopping and lowering automatically so as to show only the head. Other maneuvers for infantry or cavalry can be carried out, and the electric method allows of a good control of operations.

Summoning Police by Train Wireless.—The wireless equipment now used on the Lackawanna trains has proved very serviceable on a number of occasions. Recently when an engine broke down, a new engine was summoned by wireless communication and much time was saved. Only the other day the new means of communication was employed to summon two of the road detectives in order to arrest suspected crooks who were found riding between the baggage car and the tender. The detectives were on hand when the train pulled in at Binghamton and placed the men under arrest. No doubt wireless communication between stations and moving trains will prove useful in a thousand and one unexpected situations.

Concrete vs. Wooden Poles.—An electric service company in Abilene, Kansas, is manufacturing its own poles of reinforced concrete owing to the limited supply of timber poles. The poles are cast in three-piece wooden molds and range from 20 feet to 35 feet in length, with a diameter ranging from 6 inches at the top to 10 inches or 13 inches at the bottom, depending upon the height of the pole. The poles are octagonal in shape, and have a hollow galvanised iron core, consisting of a pipe ranging from 6 inches in diameter at the base to 2.5 inches at the top. They are reinforced with 4, 6 or 8 bars. The cost of making these poles in sizes of 20, 25, 30 and 35 feet is $2.43, $3.85, $5.26, $7.57 respectively. Cedar poles of the same sizes would cost respectively $2.05, $3.85, $6.65 and $10.20.

Science

Daylight-saving in British Columbia.—The latest part of the world to fall a victim to the daylight-saving fallacy is British Columbia, where the provincial legislature has been petitioned to advance the standard time now in use one hour from the first Sunday in April to the third Sunday in October. In support of this petition it is stated that British Columbians now sleep during three hours of daylight in summer.

Aniline Dyes in Persian Carpets.—It is believed that about 70 per cent of all carpets now woven in Persia contain at least some aniline colors. The Persian government some years ago prohibited the use of aniline dyes, in order to maintain the prestige of the carpets made in that country, but now merely imposes a tax of 6 per cent on the value of exported carpets in which these colors are used. The United States is believed to be the largest purchaser of Persian carpets.

The Marine Meteorological Charts heretofore published monthly for each of the oceans and for the Great Lakes by the U. S. Weather Bureau have been discontinued, and hereafter the only charts of this character issued by the Government will be the Pilot Charts of the Hydrographic Office. The Weather Bureau will, however, continue to collect meteorological log-books from mariners all over the world and to work up the valuable data they contain, subsequently turning the digested material over to the Hydrographic Office for use on the charts.

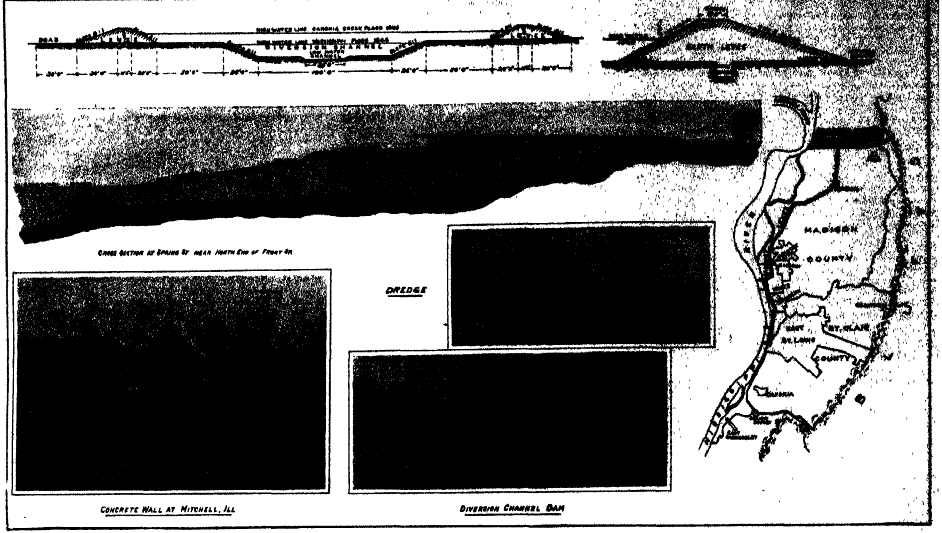
Soot-fall Observations in England.—As a result of the Smoke Abatement Conference held in London in 1912, and of the permanent Committee for the Investigation of Atmospheric Pollution, regular and systematic observations of soot-fall were begun October 1st, 1913, in the various London boroughs and 12 other important towns and cities in Great Britain with the standard instruments devised by the committee. Bailie W. B. Smith, who has charge of this work in Glasgow, recently visited the United States and endeavored to interest the municipal authorities at various places in this country to undertake similar observations.

Newspaper Botany.—Monsieur Jourdain had been talking prose all his life and never knew it until his professor told him. A certain Congressman, a couple of sessions back, immortalized himself by asking, "What are mammals?" And now Miss Lurana Sheldon and the literary editor of the *New York Times* (to say nothing of the exchange editors of the newspapers—among them the *Washington Post*—which have copied Miss Sheldon's poem without a *sic* after the word "fungus") are responsible for giving botanists a severe shock. The poem is entitled "Mistletoe Vows," and opens with the following stanza:

> "Vow to me now,"
>   Said the innocent lover;
> "Vow to me now!"
>   Boldly he glanced at the fungus above her—
> The mistletoe bough.

The museum of newspaper bulls has not received a more piquant addition since *Leslie's Weekly*, a few months ago, referred to the late Alfred Russel Wallace as "the distinguished English caricaturist."

Bradley Land: Dr. Cook Redivivus.—In an interesting and plausible little book lately published by Mr. Edwin Swift Balch, "The North Pole and Bradley Land," an energetic attempt is made to rehabilitate the character of Dr. Frederick Cook and to prove that he may, after all, have been the first man to reach the North Pole. The main points in this contention are that (1) no one has proved that Cook did not reach the pole, and most of the arguments tending to discredit him have been more or less irrelevant; (2) Cook's description of the physical conditions encountered in high latitudes tallies strikingly with Peary's; and (3) Cook's detailed account of a previously unknown land, to which he gave the name of "Bradley Land," needs only to be confirmed by some future expedition (e. g., Macmillan's or Amundsen's) to furnish a strong argument in support of the veracity of his whole narrative. Cook's "Bradley Land" lies considerably to the north of Peary's "Crocker Land," which Macmillan's expedition is hoping to rediscover and explore. Both lands were sighted at a distance by their discoverers, but not visited. Cook describes the new land, seen from his line of march, as giving the impression of two islands, though they may be part of a large land extending far to the west. Along its southern coast the land had an irregular mountainous sky line, and was perhaps 1,800 feet high. Farther north its upper surface was flat and mostly ice capped, rising in steep cliffs to about 1,200 feet. Mr. Balch points out that the verdict of the University of Copenhagen, which has militated so strongly against Cook's claims, was merely "not proven," that the ascent of Mount McKinley by Cook can never be proved or disproved, and that "from time immemorial travelers have been called liars."



Protecting East St. Louis against floods. Plan of district and details of the channels and levees.

Protecting East St. Louis Against Floods

How a Large Industrial Center Was Rendered Permanently Secure Against Inundation

By Tampton Aubuchon

THE East Side Levee and Sanitary District of Illinois extends about thirty miles along the Mississippi River, and is bounded on the east by a chain of bluffs. Within the area is a large industrial center. The principal city in the area is East St. Louis, which has a population of 80,000. The area is comparatively low and the Mississippi River formerly spread itself over a large portion of it. Through the area runs a stream called Cahokia Creek. Lying northwest of the area is a two hundred square mile plateau, which forms a water-shed for Cahokia Creek. Practically all of the waterfall of the plateau was formerly carried through the lower area by the Cahokia Creek to the Mississippi River. In the event of a heavy rainfall water from the plateau would augment the drainage of the lower area, and the Cahokia Creek would overflow its banks in the lower area High water in the Mississippi River and the Cahokia Creek would frequently occur at the same time. The Mississippi River water backing up into the channel of the Cahokia Creek would meet the downward rush of the water from the plateau and the result would be a disastrous overflow. The Mississippi River inundating the area from the west and the Cahokia Creek overflowing in the central part furnished enough water to almost submerge the area. These overflows occurred frequently and caused great inconvenience to traffic and devastation of property.

The Diversion Channel and Flood Gates.—The problem of harnessing the troublesome Cahokia Creek was partly solved by the Diversion Channel which relieves the lower area of the drainage of the plateau. At the mouth of the Cahokia Creek flood gates have been built to prevent the Mississippi River from coming up into the Cahokia Creek Channel. The Diversion Channel prevents overflow from the north and the flood gates prevent overflow from the south To protect the area against the high water of the Mississippi River the engineers have built a levee 31 miles long and seven feet higher than the flood record of 1903, which was 38 feet.

Let us begin our tour of the levee work at the extreme northern point. About where the Cahokia Creek emerges from the bluffs we find the Diversion Channel, 100 feet wide and 20 feet deep, taking the headwaters of the Cahokia Creek westward by a direct line to the Mississippi River. On both sides of it are clay dykes ten feet high. It absolutely eliminates all danger of overflow from the rainwater of the plateau. The clay dyke on the north side of the channel was built there to prevent overflow and the clay dyke on the south side of the channel is the north levee of the area.

At a distance of four miles from the head of the Diversion Channel we find a dam over which the water plunges to a level seven feet lower. On each side of the dam for a distance of about 250 feet the banks are protected with a facing of concrete and rip rap two feet thick.

The purpose of the dam is to check the flow of the water. The water which is now passing through the Diversion Channel for a distance of four and one half miles, formerly traveled about thirty miles through the lower area to the Mississippi River. The level of the bed of the Diversion Channel at its head is about twenty-five feet higher than the low water level in the Mississippi River, so that the water in the channel traveling four and one half miles, if it were not for the dam, would be falling at a rate of about five feet to the mile. Water falling at a rate of five feet to the mile is moving along at a dangerously high speed—a velocity which causes a stream to eat away its banks, undermine bridges and indulge itself in many disastrous pranks. To prevent such a condition of affairs the engineers have built the dam so as to allow the water in the Diversion Channel to have a fall of two feet to the mile. Thus the destructive head-waters of the Cahokia Creek reach the Mississippi River without tearing things asunder on their way.

Leaving the Diversion Channel, we start south and notice that the river front levee is about a mile and a half from the Mississippi River. There is no engineering reason for building the levee so far from the river at this section. The property owners in that territory which lies west of the levee did not care to bear their proportion of the expense of the levee work, so the levee was built along the least expensive route, which is back of their property, leaving them exposed to the Mississippi River high water. At Mitchell we pass a concrete wall, five feet wide at the bottom, two feet wide at the top, five feet high and one quarter of a mile long.

Leaving Mitchell we go westward to a point opposite Chouteau Island. Here the levee turns to the southwest. We move southwest until we reach Venice, where the levee approaches the river front. Provision had to be made for the drainage of the towns of Granite City, Venice and Madison. During high water the drainage of these towns is pumped across the levee through a concrete sewer. The water supply of Granite City, Venice, and Madison is pumped through pipes which run under the levee. To guard against any damage to the levee which might result from the bursting of those pipes a concrete jacket was built around that section of them which is immediately under the levee.

The drainage of the roads along the inner side of the levee during low water is conducted through the levee through automatic flood gates. The automatic flood gates hang vertically and operate like a transom. When the Mississippi River is high, its pressure being greater than the pressure from within, closes the gates. When the river recedes the drainage water presses against the gates and opens them. So far we have noticed that the levee is almost entirely made of clay, and we see the blue grass growing plentifully on both banks. Later the entire levee will be faced with concrete. In the meantime, the inhabitants of the area enjoy flood protection.

At Chouteau Island we turn to follow the levee southward. The levee reaches the river front at the Merchants Bridge. The Merchants Bridge approach is utilised as a part of the levee scheme. That side of the approach which is exposed to the current of the river was armored with a heavy facing of concrete. Just south of the Merchants Bridge approach the engineers have protected the levee with a heavy facing of rip rap. If the levee were not thoroughly protected at this point it would be likely to be badly damaged if not washed away during high water.

South of the Merchants Bridge the levee is faced with a semi-metallic substance, called slag, which is obtained from the steel foundries in the neighborhood without cost. The action of the elements upon the slag and foundry sand mixture causes it to pack and forms a solid mass with a hard surface.

As we go south we see a dredge anchored in the river and a large pipe floating on steel pontoons. Projecting out of the water at a considerable distance from the shore we see two rows of piling. These mark the new shore line. Back of the levee at this point the district board and property owners are raising the [illegible] acres of ground about 25 feet. They are doing it by means of an electrically operated dredge, equipped with a [illegible] centrifugal pump driven by a 1,000 horse-power motor.

As we move southward we come to the concrete levee in front of the principal city, East St. Louis. A new shore line is being established in front of East St. Louis, and the dredge which is now working [illegible]

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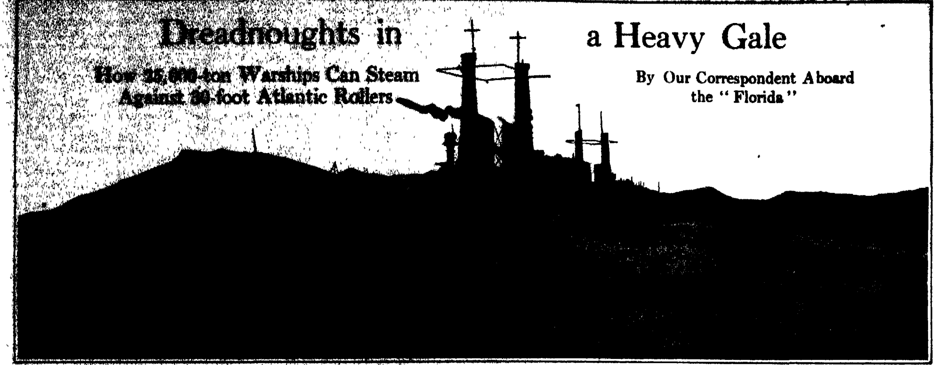
Dreadnoughts in a Heavy Gale

How 25,000-ton Warships Can Steam Against 30-foot Atlantic Rollers

By Our Correspondent Aboard the "Florida"



IT is the weather element among the many that combine to make up the efficiency of a battleship which is discussed in the present article. The subject is particularly timely as there is a strong probability that Congress will authorize two, or, perhaps, three dreadnoughts this year and the performance of these types under all conditions, but especially in rough weather, is closely watched and studied by naval constructors with a view to bettering the same design in the future.

This type of battleship was put on trial during the homeward passage of the Atlantic fleet from the Mediterranean, where it had been visiting various Italian and French ports. About one thousand miles from New York the fleet encountered a storm, which, for 24 hours, buffeted these great ships about as though they had been mere toys. At one time during the storm the wind was blowing at a rate of 90 miles an hour, and the sea was running so high that it was considered on the flagship whether it was not advisable to deviate the ships from their true course so that the immense waves would not be taken head on.

Never before had the dreadnoughts met with such weather, and even the blow encountered off Hatteras in 1912, which scattered the fleet and delayed it for several days, was mild in comparison. Some of the old, experienced men even went so far as to call the storm a typhoon. Rear Admiral Charles J. Badger, commander in chief of the fleet, ordered it to head into the teeth of the storm at a speed of 12½ knots, which, because of the friction of the wind and waves, was reduced to about 9.

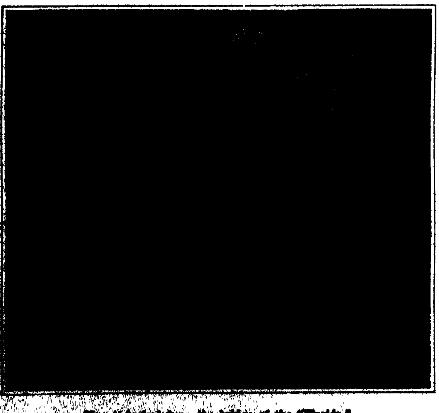
The dreadnought "Florida," upon which I was a passenger, was third in line. The "Arkansas" and the "Utah" were ahead; the "Delaware" was behind, and the "Wyoming" and "Vermont" were some five miles to the south'ard. During the most violent part of the storm the "Vermont" was disabled by a broken propeller shaft and the "Delaware" went to its assistance.

As the storm was heralded by dangerous "mares' tails" and a rapidly falling barometer, everything was battened down and secured. All hatches were dogged down, the deck ventilators closed, and an extra turn taken on the dogs of the gun ports. We turned in hardly knowing what to expect.

A succession of deafening crashes at the bows awakened everyone in the officers' quarters at about 5 o'clock in the morning. The ship was pitching and straining terribly, the air below decks was already becoming foul and for the first time I felt "squeamish." A bath would have helped some, but the forward compartment had several inches of water on its deck, and with every pitch and heave more water would find its way through the ventilators [illegible] through the [illegible]

Rising to a big sea.

The "Utah" throws a sea from her flaring bows.



How it looked from the bridge of the "Florida."

reached the bridge, which, high as it was above the water—about fifty feet—was enveloped in solid sheets of green water tossed high by the bow and hurled aft at express train speed. It was simply impossible for a man to stand the force of the wind and water as it drove across the bridge. By watch time, by stadimeter measurement, the crests of the waves were something more than a quarter of a mile apart.

The bow of the "Florida" was smashing up and down at a rate of five times a minute, reaching limits of vertical rise and fall nearly fifty feet apart. During the first thirty feet of the drop the force of gravity had full sway. The flare of the bow caught the sea and for an instant checked the drop only to lose its hold an instant later, when down went the bow again for twenty feet more. As the bows of the dreadnoughts are very pointed with a flare at the top, there was but little resistance furnished against the first period of downward drop.

With her deck at an angle of ten degrees to the horizontal, the "Florida" mounted the great waves. They passed under, leaving the bow high in the air. At times, more than thirty feet of the ship's bottom at the stem was out of water. Of course something more than air is needed to support a body weighing nearly 22,000 tons, which is about the displacement of the "Florida." The "Wyoming" and "Arkansas" class are several thousand tons heavier, while the new "Pennsylvania," now building, is a ship of 31,000 tons displacement.

I cast about for something with which all civilians are familiar to illustrate the severe motion of the ship and the experience through which the ships passed. Just enter one of the fast elevators which shoot from the basement of a skyscraper to the roof in such incredibly short time. Let the elevator drop suddenly for thirty feet. The floor seems to fall out from under the feet of the passenger and he feels almost light enough to fly. Let the elevator pause and one feels as though he were going through the floor, and just as the thought flashes through his mind that he's glad the drop is over, down goes the elevator again, with lightning-like rapidity, for fifteen or twenty feet. It stops with a convulsive shudder and then starts upward again with a jerk. About this time, to get the whole effect, someone should pour a torrent of water down the elevator shaft. Repeat this performance, and add to it a deafening noise so that conversation is impossible, five times a minute for 24 hours, and you have a suggestion of what the ships of the Atlantic battleship fleet went through.

Plunging through such a sea was the acid test of the seaworthiness of the dreadnought type, and the United States can now feel assured that the dreadnoughts can steam at their standard speeds through any sort of weather.

Even in the roughest part of the storm

the battleship "Florida" would have been able to go into action. The forward turrets were awash, but the three after turrets could have been used with a fair degree of success against an enemy several miles away. It has long been contended that a naval battle could not be fought in very rough weather I believe that this contention has been disproved, for during the worst of the blow the guns of the "Florida" were trained on the flagship "Wyoming," five miles on the port beam, and two of the pointers told me that they had no difficulty whatsoever in keeping on the target.

A number of defects in the construction of the great dreadnoughts seems to have occurred; this is not a one-man opinion, but the consensus of opinion of the naval officers in the Atlantic fleet.

The gravest defect is the placing of the secondary battery of five-inch guns, which are supposed to be used for torpedo defense; that is, to drive off torpedo boats. The guns on the "Florida" type of ship are on the gun deck and but fifteen feet above the water. Gun ports, a part of the sides of the ship, must be opened if the guns are to be used.

Even in moderate weather these gun ports may be opened only at the grave risk of flooding the various compartments of the ship. This, of course, would short-circuit the electrical apparatus and render the guns hopelessly useless.

Torpedo destroyers are being built larger and larger. There is hardly any ordinary gale that hinders their operation. Certainly there were many days and nights when the five-inch guns of the "Florida" could not have been used, although the weather was mild enough to permit destroyers to operate with a reasonable probability of success. It would be under these conditions that a clever strategist would send in his destroyers to torpedo an enemy's fleet. The only defense that the "Florida" type would have, would be the great 12-inch guns.

Either these guns of the secondary battery should be placed on a higher deck or should be removed entirely, thus reducing the tonnage by many hundreds of tons. The ordnance experts state that if the secondary battery is placed on a higher deck where it can operate in any sea in which a destroyer can operate, the center of gravity of the ship will be disturbed and that the guns would have to do without armor. Armor may or may not be of great importance for the protection of the secondary battery; but as it is placed now, the secondary battery, under heavy weather conditions, is practically useless for the purpose for which it is intended. The larger the destroyers become (and they are growing in tonnage each year by leaps and bounds) the more useless becomes the secondary battery; for, the larger the destroyer, the greater the seaway in which she can operate.

Considerable difficulty has been experienced in lashing the anchors for sea. The bill-board type of anchor has been abandoned, and on the dreadnoughts the anchor chain is drawn taut by the anchor engine and is secured. The anchor itself is not lashed by chains and ropes with the result that sometimes it works loose and in a heavy sea will batter the ship's side unmercifully. The anchor of the "Florida," which weighed several tons, worked loose during the gale, and, with every heave of the ship, would batter the hawse pipe.

The experiment of placing the officers' quarters forward under the forecastle is condemned by nearly every officer in the fleet. The motion is so severe that they cannot do the work which must be done in their rooms, and, when at sea, the wardroom, cut off from the rest of the ship, is so stuffy and uncomfortable as to be unbearable.

On the "Florida" there were two five-inch guns in the wardroom. It was impossible to tightly close the gun ports, with the result that several times the officers dined with an inch or two of water on the deck.

On the whole, the dreadnought type of ship has shown its absolute superiority over all other classes of craft for main line-of-battle position The motion was severe; but at no time would it have been impossible to go into action at five minutes notice. The ability of the ships to maintain a standard speed through any kind of weather will, of course, have an important bearing on any naval actions into which the dreadnought type may be ordered. It is probable that in the dreadnoughts to be built in the future some change will be made in the disposition of the secondary battery; but it is certain that so far as the general design is concerned the type will be standard for many years to come. As to the lines of the ship and the great tonnage found in the newer dreadnoughts, no change will be made until great strides have been accomplishd in the art of marine construction; for the type is as nearly perfect as possible.

The Symons Gold Medal of the Royal Meteorological Society awarded every two years, and alternately to a British and a foreign meteorologist, will be presented at the annual meeting of the Society next January to Mr. W. H. Dines, F.R.S., the leading English student of the upper air.

SCIENTIFIC AMERICAN

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Most Needed Invention

To the Editor of the SCIENTIFIC AMERICAN:

The most needed invention, the writer believes, is a means of harnessing electricity in its transit from heaven to earth in sufficient quantities to be of practical use for power, heat, and light. Benjamin Franklin, before we were born, harnessed a sufficient quantity of it to produce a spark, and it seems that all of our inventors since then have failed to do more in that line.

The writer believes this as sure to come as that we have the telephone and wireless telegraph and aeroplane. Wonders never cease. It is as it were but a fortnight since the idea of an aeronaut flying head down, looping the loop, and even defying the skill of the birds, who have been supreme in the air all the past centuries. Let the minds of our inventors center upon the harnessing of the boundless electric forces and see how soon advancement will be recorded.

Indianapolis, Ind. J. A. MCANULTY.

Student Labor and Public Works

To the Editor of the SCIENTIFIC AMERICAN:

I noticed in the SCIENTIFIC AMERICAN for December 6th a short article on student labor on public works. The Dickinson County High School has been employing students in various occupations for the past two years. The high school has a farm and a school garden. A part of the labor on these has been performed by students. The mechanics department of the institution makes hay racks, water troughs, feed troughs, singletrees, doubletrees, neck yokes, wagon tongues, etc., for the farmers of the surrounding country. It also repaired last year two gasoline engines. A new shop for iron work is now nearing completion. All of the wood work, including the making of the window frames, doors, roofing, etc., has been done by student labor. The cement floor and walks will also be put in by students W. S. ROSS.

Chapman, Kans.

A Comparison of Battleships

To the Editor of the SCIENTIFIC AMERICAN:

Your article in the SCIENTIFIC AMERICAN SUPPLEMENT of November 22nd comparing so-called contemporary British and American battleships is a little unfair to British designers and not up to the usual SCIENTIFIC AMERICAN standard of accuracy. As the British and American fleets can never, by any conceivable circumstances, be arrayed except on the same side, I think you will agree that the facts can be discussed and compared openly and without fear, and I hope you will allow me briefly to refer to the matter. You compare the "Nevada" and "Orion," but I cannot imagine how you can consider this a fair comparison seeing that the "Orion" was actually afloat in 1910 and completed in 1911, while the "Nevada" will not be ready until 1915.

I presume you select the "Nevada" as being as powerful a battleship as you have launched; and if you wish for a contemporary British ship of the same date and most powerful type, you will find her in the "Queen Elizabeth."

These two fine ships compare as follows:

	"Nevada."	"Queen Elizabeth."
Date of launch	1913	1913
Date of completion....	1915	1914
Tonnage	27,500	27,500
Thickness of armor belt	13½ in.	13½ in.
Designed speed	20½ knots	25 knots
Armament	10—14 in. 21—5 in.	8—15 in. 16—6 in.
Weight of broadside...	14,000 lbs.	15,600 lbs.
Fire direct ahead or astern	7,000 lbs.	7,800 lbs.
Torpedo tubes	4	5

Of these two boats launched at the same time, of identically the same tonnage, the "Queen Elizabeth" is inferior in no particular and decidedly superior in many. H. ALLAN MORGAN.

Holmwood, Knutsford, Cheshire, England.

The Velocity of Wireless Waves

To the Editor of the SCIENTIFIC AMERICAN:

The scheme for measuring the velocity of wireless waves proposed by Mr. Riggs in your issue of November 15th, strikes me as very interesting and ingenious, but I think that the problem is even simpler than he indicates. His proposal is that clocks at the Paris and Arlington stations should send out signals each second and that these should be received on chronographic recorders. Why not have the signal sent from one end and echoed back from the other as soon as convenient afterward, with the record made at each end of the time elapsed between sending and receiving? Thus, suppose the Paris operator sends first and the Washington station answers within half a second. The return would be received at Paris after an interval equal to the delay at the other end plus twice the time required for the travel of the wave.

It is possible to anticipate approximately the determination of the time of transit. Hertzian waves are undulations of the same ether which carries the radiations of light and heat. The speed of the latter waves has been measured many times with considerable accuracy, and is close to 186,000 miles per second. Radiant heat, light of various colors and the invisible ultra-violet radiation differ among themselves only in wave-length. The speed is the same for all, and all are of the same type, namely, transverse vibrations like those on the surface of water. It appears that wireless waves are of exactly the same kind, but thousands of times longer than the minute fractions of an inch which measure the length of light and heat waves.

From Paris to Washington it is approximately 4,000 miles. At 186,000 miles per second, this means that the signal will reach Washington about 0.022 second after leaving Paris.

For recording intervals of time so short as this with accuracy worthy of the opportunity, the ordinary chronograph would seem hardly suitable. It occurs to me that a photographic appliance might be devised to do the work a great deal better. Some such arrangement, for example, as this: A circular sensitive plate rotated at high speed in a light-tight case containing a small window which gradually travels radially. A weak constant light traces through the window a spiral line on the plate. The receiver of the wireless wave actuates a small mirror which throws an intense beam of light across the window at every vibration, but normally the beam strikes the case at one side of the opening. The same instrument might act to record the sending of the signal, or the light of the spark itself coming through the window could make the mark. Then, knowing the speed of rotation of the plate, or having photographic marks made at suitable intervals of time along the spiral, the determination of the lapse of time would be easy.

A weak impulse which had traveled 4,000 miles should be much more positive in its action upon some such delicate apparatus as that needed to deflect a tiny mirror than upon a machine which could make a mechanical mark upon a paper record. The device to actuate the mirror might be some sort of D'Arsonval galvanometer, or perhaps even a telephone receiver with the mirror glued to the diaphragm.

Berkeley, Cal. HOWARD H. BLISS.

Lunar Rainbow

To the Editor of the SCIENTIFIC AMERICAN:

Have noticed your recent articles on lunar rainbows and rainbows seen after sunset, and it occurred to me that you might be interested in a report of a lunar rainbow observed by the writer on the night of September 18th, 1913, at 9:15 P. M.

This was observed from a Vermont Central train while running between Mount Hermon and Northfield, Mass. There was a bright moon high in the sky, and nearly full at the time. Tiny needle points of rain showed on the panes, and the rainbow was observed on the west side of the track, apparently about five hundred feet distance. The most striking features were that the southern end of the bow rested upon the pasture, while the northern end rested upon the tops of a group of trees apparently sheltering a cemetery. All the colors of the usual rainbow seemed to be present, except they were of a lighter shade.

This same bow was observed by Mr. F. H. Whitcomb of New London, Conn. JAMES W. AUGHILTREE.

New York city.

The Remarkable Long Distance Flight of Védrines

THE Paris to Cairo flight places Pierre Jules Védrines at the head of long-distance aviators. Rodgers's 4,000-mile journey from Sheepshead Bay to San Francisco in 1912 and Brindejonc des Moulinais's Paris-Warsaw-St. Petersburg-Paris round of 3,000 miles this year were easy flights in comparison.

Rodgers and Brindejonc des Moulinais flew over civilized lands. Védrines made himself subject to arrest in Germany by going outside the prescribed area, was fired on in Servia; crossed the battlefields of Thrace, and traversed mountains 16,000 feet high on his way from Constantinople.

Communication Between Aircraft and the Ground[*]

Adapting Wireless to the Requirements of Military Aircraft

By Major H. Bannerman-Phillips

RECONNAISSANCE by aircraft has now become an established and recognized necessity in military operations of any magnitude, and if thus far of supplementary value only for warfare at sea, it is nevertheless of such importance that every nation which aspires to be a naval power finds it necessary to study the subject.

It is impossible to say how far aircraft will be useful for purposes of aggression, but at present they are to be reckoned upon only for obtaining information. How to convey that information to headquarters with the least possible loss of time is frequently of as much importance as how to procure it. Aircraft travel such distances on reconnaissance that visual signaling is often impracticable, besides being liable to be read by the enemy, and at short distances it is quicker to drop written messages at pre-arranged spots or to return and report in person.

It is of course feasible for the observer who is responsible for the results of the reconnaissance to descend from an airship by means of a parachute at a given point, say near the headquarters staff in the field, the vessel which carried him being then free to proceed to the air service camp to refit, without loss of time. Major Maitland, an officer of the British Royal Flying Corps, proved this on October 18th last by dropping from the airship "Delta" in a parachute by way of experiment when at an altitude of about 2,000 feet with complete success. He had dropped from a balloon on a previous occasion, in similar fashion.

The Possibilities of Wireless.

Wireless telegraphy therefore is the best method of sending messages, although it is open to the objection that its use may betray the presence of the scouting aircraft to the enemy, especially at night, when it might otherwise escape notice in the case of an airship. The weight of the apparatus is another matter which is a disadvantage and which practically reduces its use on aeroplanes to comparatively short distances. Then again since wireless messages are liable to be picked up and read by the enemy, it will usually be advisable to send them in cipher. This involves loss of time spent in de-coding them, and time is nearly always precious when there is a question of conveying information, as already pointed out. Therefore it may be simpler, quicker and altogether more satisfactory, especially in the case of an aeroplane, to return to headquarters with the results of a reconnaissance, than to code and send it and have it de-coded at the ground receiving station, whence it may have to be again sent on by messenger or signal to headquarters.

Even in the case of code messages, the enemy may possess officers skilled in cryptography who will be able in a reasonable time to discover the code and read them.

The aeroplane in its present state of development is at a considerable disadvantage as compared with the dirigible in regard to the use of wireless telegraphy. The continuous vibration and noise of engines and propeller render it impossible to receive any message whatever,[†] and unless it carries an observer as well as a pilot, the sending of anything more than the very simplest report would be out of the question. Considerations of weight and aerial militate against sending farther than about thirty miles, and if it is considered necessary to carry an observer, oil and fuel for long-distance flight, camera and possibly an automatic rifle and supply of ammunition for defensive purposes, the additional weight of wireless apparatus will become a very serious consideration. It would be also a doubtful advantage in view of the time to be taken in sending messages by code when a return can be made at 50 or 60 miles an hour for the purpose of reporting direct to headquarters.

With the airship or at any rate with the large weight-carrying airships, the case is reversed. To begin with, messages can be sent up to 200 miles, either to a permanent coast or other station, or to a cart-station such as those of the Marconi Wireless Telegraph Company, specially designed for military work. It is quite feasible to stop the engines for a time in order to receive instructions on the subject of the reconnaissance in answer to reports sent. According to present rates of speed an airship could cover the 200 miles of the outward journey in four to five hours, and after hovering or sailing slowly for an hour or so over the area to be reconnoitered (while simultaneous notes were made by different observers and photographs taken), could return in another four or five hours with the negatives developed and ready to supplement the reports. In the meanwhile these latter would be sent on ahead by wireless at once, and corroboration, personal explanation and answer to questions concerning details would follow on arrival at headquarters.

Flashes and Their Utility.

Methods of visual signaling between aircraft and aircraft in mid-air or between aircraft and the ground, include flashing lamps at night from either aeroplanes or airships, and semaphore from the latter by day. Written messages can be dropped by parachute. Where it is inadvisable to return and report, direct wireless telegraphy is by far the best of all methods of communication. Any wireless system which can be worked on land answers practically as well in mid-air, though of course the weight to be carried is a very important consideration and makes certain systems unsuitable.

The British Air Service has its own system, and the Rouget is also much used. A satisfactory aerial for aircraft is the trailing wire which can be kept rolled upon a drum and unrolled and rolled up again when not in use. A safety catch can be arranged in connection with this form of aerial, so that if by accident it should become entangled in anything during flight, the pull would release it and thus obviate damage.[*]

With regard to portable ground stations to be used in communications by wireless with aircraft, it would take too long to compare the merits of different systems. It must suffice to give a short description without too many details, of some of the best known—those of the Marconi Company, who have made a special study of the type. The largest of these stations has a range of about 200 miles. It is designed for wheel transport, the time required to erect or dismantle is 20 minutes with 8 men; 3 men could do the work, but it would take longer, naturally. The weight of the station alone is about 784 pounds. For transport it is normally divided into two horse-drawn units, or the whole can be conveyed as one unit, if self-propelled. In the former case the limbered wagon type of vehicle has been adopted. The first limber carries the generating plant and the wagon carries the transmitting and receiving apparatus; the second limber carries a supply of gasoline and spare parts, and the wagon carries the masts with all their gear, as well as the aerial and earth wires. The prime mover of the station consists of a 2-cylinder gasoline engine having an output of about 8 horse-power. It runs at a speed of 2,000 revolutions per minute, and is air-cooled by a special blower mounted on the flywheel, which keeps a continual blast of air circulating round the cylinders.

The engine is direct coupled on an aluminium bed-plate to a self-exciting alternator having an output of about 2 kilowatts. Mounted on the shaft of this alternator at the end remote from the engine is the disk discharger, the function of the latter being to break up the train of waves into groups of waves so as to give the sound produced in the receivers a musical note. The current from the generator is carried by a flexible cable to the instrument cart, where it passes through the manipulating key to the transformer. Here it is transformed to a high voltage current which charges the battery of condensers in the primary high-frequency circuit. These condensers discharge themselves through the disk discharger (already mentioned) and through the primary of the high-frequency transformer, the secondary of this high-frequency transformer being connected to the aerial on one side and to the earth on the other side.

Both the primary and the secondary circuits of this high-frequency transformer are connected through suitable inductances for changing the wave-length, and through the change-time switch, by means of which the operator is able to change his wave-length at will. The receiving apparatus is also carried in this cart and consists of 2 separate receivers, one receiver being specially adapted for the change-time switch, and the other receiver being of a more simple type and arranged for tuning up quickly to any wave-length between 500 and 1,400 meters.

The antenna consists of 2 woven wires about 500 feet long, which are supported by 2 masts 70 feet high. These masts are carried in sections and erected by means of a derrick built up of 2 mast-sections.

When it is necessary for a mobile wireless telegraph station to be carried by pack transport the engine and dynamo are mounted on either side of a rigid pack-saddle frame adjustable to suit different sized animals. The saddle frame acts as a bed-plate for the generating set, and to remove the saddle from the back of a horse and get the station into operation takes only one minute. This type of saddle is used to carry all the four loads of the "Cavalry Station," which can move at a gallop, if required.

An even lighter station, but with a range of only 10 miles, called the "Knapsack" station, can be transported by 4 men, who each carry a load of 20 to 30 pounds, strapped to their backs. This would be useful in connection with aircraft principally in mountainous country.

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[*] The cover design of this week's issue of the SCIENTIFIC AMERICAN represents a type of portable, wireless apparatus which has been designed by Mr. William Dubilier of New York for use on aeroplanes, and which has proven itself remarkably efficient in tests conducted at Aldershot last autumn by British army officers. The apparatus overcomes the principal objections mentioned in Major Bannerman-Phillips article. For the benefit of those familiar with wireless it may be stated that in Mr. Dubilier's apparatus sine waves of a musical frequency are produced for the first time from continuous current without the use of a rotary converter. An apparatus of 250 watts capacity weighs only 20 pounds complete for transmitting, without the generator, which itself is not larger than an ordinary fan motor and weighs 16 pounds. The principle of operation depends on obtaining a series of unidirectional impulses by a condenser discharge, pulsating currents following one another at regular intervals at a frequency of 500 per second. These impulses are produced from a primary direct current. It is possible to produce any frequency up to 1,000, the apparatus weighing complete not over 40 pounds and having an over-water range of about 250 miles on shipboard. An instrument weighing 15 pounds and occupying a space of less than one third of a cubic foot transmitted signals 30 miles to a portable aerial in tests conducted by the British government.—EDITOR.

[†] It has been [illegible] possible to receive signals visually by [illegible]. This would obviate the difficulty [illegible].—EDITOR.

[*] Our cover design shows how the aerial may be disposed on the wings.—EDITOR.

The Lobster and Its Eggs

THE way in which the lobster carries out its transformations from the egg to the adult stage has been most obscure up to the present time, but the problem may now be said to be solved by the researches made by Prof. Bouvier of the Paris Natural History Museum. These he carried out at the Plymouth maritime laboratory which is well fitted out for the purpose; the character of the coast is such that the lobsters are abundant among the rocks surrounding the lighthouse and they tend to remain at this place. After hatching, the young have an entirely different form from what we know, and in the larval state they are quite transparent. The body has three pairs of swimmers and is flat like a leaf, hence the name "phyllosoma" which is given them. Of very minute size, they live entirely in the water. No less than nine stages of transformation are observed between the larva and the perfect state, but the larva could not be cultivated up to the present. On the other hand, there were a few rare specimens found of what is known as "puerulus," considered by some as one stage in the evolution, but this was not certain. Prof. Bouvier now proves this to be a fact, and it represents the lobster at the time when it ceases to swim and takes up its lodging in the rocks. At this time it is about an inch long and quite transparent, with a rather soft shell. As it is hard to see or to capture, but few specimens exist at Paris, London, and others places. However, a fortunate catch at Plymouth brought up a "puerulus" which was being transformed into a lobster, so that the proof is now complete. It is stated that the time for the evolution from hatching of the larva up to the perfect lobster form is only two months.

Substitutes for Celluloid

THE increasing use of celluloid for the manufacture of imitation ivory, horn, shell, linen, wood, glass, porcelain, etc., is due to the cheapness of this mixture of pyroxylin and camphor. It has, however, the serious drawback of being highly inflammable, and even explosive at high temperatures.

Hence substitutes lacking this dangerous property have long been sought. Such a one is acetyl-cellulose, made by the action of acetic acid on pure cellulose. This, however, is more costly, and therefore has not made its way except where price is a secondary consideration.

Very recently, however, substitutes have been invented which are not only effective, but cheap. These are *viscose* and *formyl-cellulose*, already known because of their employment in making artificial silk.

While they are not as yet utilizable for objects which must have great solidity like those of horn and ivory, it is safe to predict a great future for them, since already blocks of *viscoid* have been produced which can be readily colored, polished, and worked.

Morning and Evening Stars for 1914

A Transit of Mercury

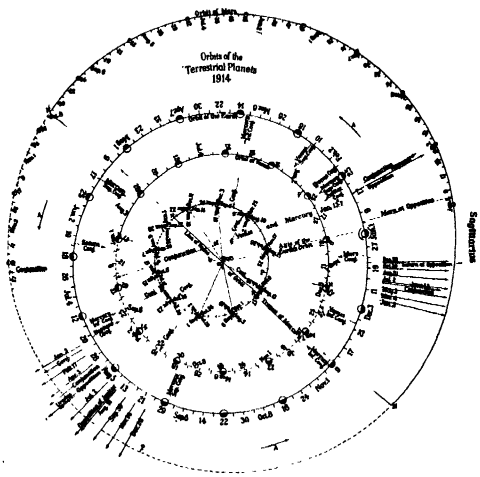
By Frederic R. Honey, Trinity College

THE purpose of this annual paper is to show how morning and evening stars may be determined by inspection of the accompanying plot, and at the same time to exhibit graphically the principal elements of the solar system, to the end that the reader may familiarize himself with the relative positions of all the planets at any time during the year. Anything beyond a general inclusion of the asteroids has been avoided, inasmuch as these eight hundred little bodies occupying the space between Mars and Jupiter, would require a separate article for extensive treatment.

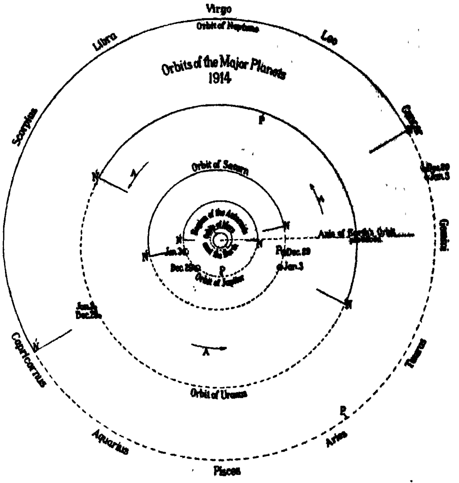
The year 1914 includes in its record the interesting departure from the usual, in a transit of Mercury which occurs in November of this year, when a tiny speck representing a planet 3,000 miles in diameter will traverse a chord of the Sun's disk, accomplishing the journey in a little over four hours.

The Sun.

The Sun, which controls the motions of the planets, is a self-luminous globe whose diameter is 864,367 miles, or a little over one and eight tenths the diameter of the moon's orbit. Its volume is 1,300,000 times the Earth's volume. The Sun rotates on its axis, which is inclined to the ecliptic, in about twenty-five and a quarter days, and in the same direction as the revolution of the planets in their orbits, as illustrated by the arrows *A* in the plots of the orbits of the major and terrestrial planets. The Sun's apparent diameter, which subtends an angle of a little over ½ degree, varies, slightly during the year. It subtends a maximum angle when the Earth is at perihelion in January; and a minimum angle when the earth is at aphelion in July.



The orbits of the terrestrial planets for 1914.



The orbits of the major planets for 1914.

The Terrestrial Planets.

The planets revolve around the Sun in the same direction in elliptic orbits, with the Sun at one focus, conforming to Kepler's first law of planetary motion. The orbital planes are inclined at small angles to the ecliptic, which is the plane of the Earth's orbit; and the intersection of each plane with that of the ecliptic is called the line of nodes. This line passes through the Sun, and in order to avoid confusion it is drawn only in the plot of Mercury's orbit. A part of this line is shown, however, in each of the plots of the orbits of all the planets at *N* and *N'*, where the planet passes from one side of the ecliptic to the other. If this page be placed in a horizontal position, it may be regarded as the plane of the ecliptic; and for convenience of reference it is conceived to divide space into two parts, viz., that which is below and above the ecliptic. *N* is called the ascending node, and *N'* the descending node; perihelion, or point of nearest approach to the Sun, is at *P*. The planets are divided into two groups of four, the terrestrial and major planets; the orbits of the latter are drawn to a scale which is very much reduced; and the great difference between the scales will be apparent on comparing the orbits of the Earth and Mars in the two plots.

The Earth.

Our planet, which may be regarded as a moving observatory, revolves around the Sun in 365¼ days at a mean distance of 92,894,767 miles, and at a mean velocity in its orbit of 18½ miles per second. The axis of the Earth is inclined to the plane of the ecliptic at an angle of about 66½ degrees, and the Earth rotates uniformly in a sidereal day, which is nearly four minutes shorter than a mean solar day, in the direction of the arrows (see position for January 1st). The center of the orbit is at *a*, which is at a distance of a little over 1,500,000 miles from the Sun (= *e*, the eccentricity). At the perihelion passage in January the Earth is therefore more than 3,000,000 miles nearer the Sun than it is at aphelion in July. The positions of the Earth and of all the terrestrial planets are shown at intervals of four days.

Mercury.

The great velocity and variability of the planet's motion, by which the perihelion and aphelion passages are made respectively at the rates of 35 and 23 miles per second, are due to the close proximity of Mercury to the Sun, and to the eccentricity of its orbit, which is greater than that of the orbits of any of the terrestrial or major planets. Mercury's mean distance from the Sun, expressed in terms of the Earth's distance, is 0.3871; and the eccentricity, bringing the center of the orbit to *b*, is a little over one fifth. In representing it on the plane of the ecliptic its true form is obviously distorted, but the deviation is scarcely apparent in the plot. The maximum angle which a radius vector forms with the plane of the ecliptic is 7 degrees, the inclination of the planet's orbit, and since the projection of a line on a plane is equal to its true length multiplied by the cosine of the angle which the line forms with the plane, the maximum diminution in the present case is less than one hundredth of its length (cos 7 deg. = 0.9925).

The planet's period is very nearly 88 days (87.97 days) and its position is shown at intervals of two days. Kepler's second law, the radius vector sweeps out equal areas in equal times, is illustrated. For example, taking the Sun's center as the common vertex of two triangles whose bases, representing equal periods of time, are respectively that part of the orbit between the dates September 6th and September 14th, and that part between the dates October 24th and November, 1st, the areas of these triangles are equal.

Since Mercury's orbit is inclined at a greater angle than that of any of the terrestrial or major planets, it is clear that the projections of the orbits of the other planets in both plots do not differ appreciably from their true form.

Venus.

On account of the small eccentricity which is scarcely visible in the plot, the orbit of Venus differs very little from a circle, and the motion of the planet is nearly uniform at the rate of 21.9 miles per second. The orbital plane is inclined at an angle which is a little less than one half that of Mercury. The planet's distance from the Sun, in terms of the Earth's mean distance, is 0.723; and the period of revolution is 224.7 days. Thus Venus makes more than one and a half revolutions during the year. On August 19th the planet returns to a point on the orbit which is very near the position of January 1st, a distance traversed in seven tenths of a day. The dates until August 5th are attached without the orbit; for the rest of the year they are shown within the orbit.

Mars.

The plane of the orbit of Mars is inclined at an angle of only 1.85 degrees. While the eccentricity is less than that of Mercury's orbit, its linear eccentricity, or actual distance from the Sun to the center *c*, which is nearly one tenth the mean distance, is much greater than the corresponding measurement on the axis of Mercury's orbit. The mean velocity is 15 miles per second; the mean distance from the Sun is 1.5237 times the Earth's distance; and the period of revolution is 1.88 years.

The Major Planets.

The following table gives some of the elements of the orbits of the major planets. The mean distances are given in terms of the Earth's mean distance.

Planet.	Mean Distance.	Period Years.	Velocity miles per Second.	Eccentricity.	Inclination to Ecliptic.
Jupiter....	5.20	11.86	8.1	0.048	1.31°
Saturn.....	9.54	29.46	6.0	0.056	2.49°
Uranus.....	19.19	84.02	4.2	0.047	0.77°
Neptune....	30.07	164.79	3.4	0.009	1.78°

In the plot of the orbits of the terrestrial planets, the positions of Jupiter as seen from the Sun are indicated by arrows at intervals of forty-five days; and Saturn's positions at intervals of sixty days. The positions of Uranus and Neptune are given at the dates of conjunction and opposition. In the plot of the orbits of the major planets, the positions are shown for January 3rd and December 29th.

[illegible]

[illegible] Green-[illegible]

[illegible] GREENWICH TIME.

Date.	Conjunctions.	Oppositions.
Jan. [illegible]		Mars Neptune
[illegible]	Jupiter	
[illegible]	Mercury (sup.)	
[illegible]	[illegible]	
[illegible]	Venus (sup.)	
[illegible]	Mercury (inf.)	
[illegible]	Mercury (sup.)	
[illegible]	[illegible]	
[illegible]	Mercury (inf.)	
[illegible]	Neptune	
Aug. [illegible]		Uranus Jupiter
[illegible]	Mercury (sup.)	
Nov. [illegible]	Mercury (inf.)	
[illegible]	Venus (inf.)	
Dec. [illegible]		Saturn
[illegible]	Mars	

Conjunctions of the Planets.

The first conjunction in the year, that of Mercury and Venus, January 13th, is the only one which is illustrated in the plot. The reader will easily discover a conjunction, by an inspection of the plot which shows the positions of the Earth and of the planets at the date given in the table.

CONJUNCTIONS OF THE PLANETS.

Date.	Planets.	Date.	Planets.
Jan. 13	Mercury and Venus	June 16	Venus and Neptune
" 22	Mercury and Jupiter	" 25	Mercury and Neptune
" 25	Venus and Jupiter	July 7	Mercury and Neptune
" 26	Mercury and Uranus	Aug. 5	Venus and Mars
" 30	Venus and Uranus	" 9	Mercury and Neptune
Mar. 3	Jupiter and Uranus	Oct. 5	Mercury and Mars
" 5	Mercury and Venus	" 20	Mercury and Mars
Apr. 20	Mars and Neptune	Nov. 21	Venus and Mars
May 16	Venus and Saturn	Dec. 7	Mercury and Venus
" 26	Mercury and Saturn		

A Transit of Mercury.

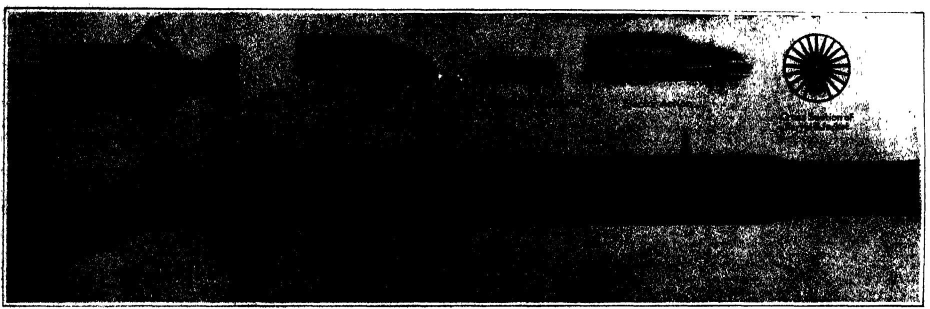
A transit of Mercury across the Sun's disk can occur only in the month of May or November, and when the planet is near one of the nodes of the orbit. If the line of the nodes be produced in both directions, it will be seen that it intersects the Earth's orbit at points which our planet reaches early in these months. On account of the great eccentricity of Mercury's orbit, he comes very much nearer the Sun at the ascending node when he is approaching perihelion; and as a consequence November transits are far more frequent than those which occur in the month of May. The intervals of time between two consecutive November transits, may be either seven or thirteen years.

Mercury's period (nearly 88 days) expressed in a fraction of a year is 0.24085; and $\frac{7}{0.24085} = 29.06$; i. e., Mercury makes a very little over 29 revolutions in seven years. Thus one transit will follow another, seven years later, provided the planet is near enough to the node at the later date; and since during this period it makes a small fraction over 29 revolutions, the [illegible] occur earlier in the month. The date of the last transit was November 14th, 1907. The date this year will be November 7th. The planet will reach [illegible] the [illegible] of the Sun's disk a few minutes [illegible] Greenwich [illegible]. Owing to the difference [illegible] between [illegible] and Washington, the [illegible] five hours [illegible] with Mercury [illegible]

[illegible] very nearly fifty-four revolutions; thus $\frac{13}{0.24085} = 53.98$; i. e., one transit may succeed another, after an interval of thirteen years, provided Mercury is near enough to the node at the second date, in which event the transit occurs later in the month. Transits occur at consecutive intervals represented by the series 7, 13, 13, 13, 7, 13, 13, 13, 7, etc. The sum of any four consecutive periods is 46 years, which always includes one period of 7 and three of 13 years. Dividing 46 by Mercury's period we have $\frac{46}{0.24085} = 190.99$. Thus, it appears that after an interval of 46 years, and 191 revolutions of the planet, a transit occurs when the Earth and Mercury are near the same point in each orbit. The following dates when transits occurred, illustrate these intervals: November 4th, 1867; November 7th, 1881; November 10th, 1894; November 14th, 1907; November 7th, 1914. The first observation of a transit of Mercury was made in November, 1631; and it will be seen that this date belongs to the series; thus 1907 — 1631 = 276 = 46 × 6.

How to Find Morning and Evening Stars.

Morning and evening stars for any day in the year may be found by placing the plot of the terrestrial planets in a position where the date attached to the Earth may be read without turning the head. In this position a straight edge through the Earth and the Sun will divide the planets into two groups; those on the right which rise before the Sun, and which are therefore morning stars, and those on the left, which set after the Sun, and are evening stars. Between superior and inferior conjunction, Venus and Mercury are evening stars; and between inferior and superior conjunction, they are morning stars. Before conjunction a planet whose orbit is outside the Earth's orbit is evening star; after conjunction it is morning star. At the date of opposition, when a planet is above the horizon before and after midnight, it is both morning and evening star. The Earth rotates in the direction of the arrows (see position for January 1st). Between sun-set and sun-rise, the observer is on that half of the Earth's surface which is in shadow. At sun-rise he emerges from it; and at sun-set he enters it. By an inspection of the plot it is a simple matter to determine the relative positions of the observer to the Sun and all the planets during the day or night, at any assigned date.



This gun, weighing only 26½ pounds and firing 800 shots per minute at maximum speed, is specially adapted for military aeroplanes.

Details of the Lewis air-cooled machine gun.

The Lewis Air-cooled Machine Gun

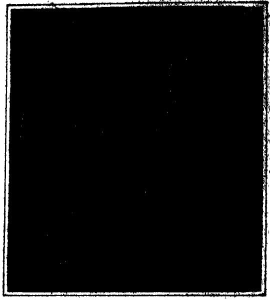
WE present illustrations of an air-cooled machine gun, the invention of Col. I. N. Lewis, formerly of the United States Army, which has been undergoing firing trials successfully in Russia, Belgium, Italy, Austria, and Sweden, and is now being tested by a special board of officers of the United States Army. Col. Lewis is known to our readers as the inventor of the Lewis depression rangefinder, which is in service on the coast defense batteries of the United States seaboard.

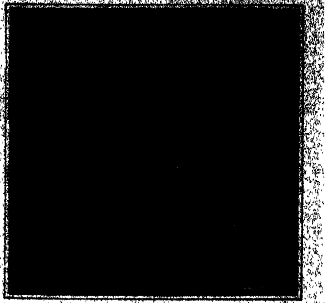
Two problems of special difficulty confront the designer of an automatic gun timed to fire a large number of shots at high speed, namely, keeping the barrel cool, and feeding the loaded cartridges and ejecting same when empty. By studying the accompanying illustrations, it will be seen that the barrel is inclosed in a close-fitting jacket, made of aluminium and formed with a number of radiating longitudinal fins. Fitting closely over the outside edges of these is a light steel casing 3⅝ inches in diameter. This extends beyond the forward end of the barrel. At each discharge the blast of gases from the muzzle acts as a kind of pump plunger and sucks currents of fresh air through the V-shaped channels surrounding the barrel. There is a passage of fresh cold air at each discharge, and this serves to cool the barrel without the use of water. Aluminium has six times the heat conductivity of steel, and the heat conveyed from the barrel to the aluminium fins is rapidly dissipated by the continuous passage of currents of air between them. The first few hundred rounds raises the temperature of the barrel to 330 deg. Fahr. Thereafter it rises more slowly, and after one thousand rounds have been fired it does not exceed 440 deg. Fahr. By varying the dimensions and form of the aluminium jacket, it is claimed that any desired limit of cooling may be secured.

Col. Lewis considers that the method employed for feeding the cartridges is an even more important improvement than the cooling device. In this design, the belts or long metal slips used in other guns of this character, are abolished, and in their place is a horizontal balanced rotary magazine, shown in part plan and in vertical section, in which the cartridges are placed radially, the magazine being attached upside down, over the breech opening, and held in place by a pivot stud on the receiver body. The operating spring is placed on the bottom of the gun, and is far enough removed from the barrel to avoid being affected by the heat of the barrel.

The energy required for loading, closing the breech, firing the cartridge and ejecting the empty case is obtained by diverting some of the gases of discharge through a small hole, drilled through the bottom of the barrel, a few inches from the muzzle. These gases act on a piston in a cylinder carried immediately beneath the barrel, the piston being at the front end of a long piston rod, the rear end of which is connected to the breech-operating mechanism. Col. Lewis describes the action as follows. When the gases act on the piston, the energy stored in the moving mass overcomes the resistance due to the work of unlocking the breech, extracting and ejecting the shell, turning the magazine to bring the next cartridge into place, and winding up the operating spring, which spring serves subsequently to close the breech and fire the shot. This complete series of operations may be completed at the rate of 800 times a minute; but the rapidity of fire can be regulated to a lower speed by adjusting the area of the hole through which the gases enter to act on the piston. The operating spring below the barrel at the breech is similar to that used in clocks, and it is mounted in a small oil- and dust-tight case in front of the trigger. The toothed periphery of the spring drum engages a toothed rack, formed on the underside of the piston operating rod. When the last is driven back by the gases, opening the breech and ejecting the spent cartridge, the spring is wound up by the action of the rack on the toothed periphery of the spring case. When the momentum of the rod has been expended in its backward travel, the spring comes into action, casting the rod back to its starting position, closing the breech and firing the charge. An additional advantage is that the friction set up by the gases impinging on the end of the tubular steel casing diminishes the force of the recoil one half. Hence, it is possible to fire the gun when holding it at arm's length—an advantage which makes it peculiarly fitted for use on aircraft. The weight of the gun is 26½ pounds.

The Canadian Arctic Expedition.—Press dispatches from Nome, Alaska, state that the "Karluk," the principal vessel of Stefánsson's arctic expedition, succeeded in getting out of the unseasonably heavy ice that now blockades the Arctic shore of Alaska, and making winter quarters. The other three vessels of the expedition, the "Alaska," "Mary Sachs," and "Belvedere," are fast in the ice, and therefore are not likely to reach their proposed base in Victoria Land this season.





Three stages in the interesting process of forging a ring, under the steam hammer, for a bevel ring gear.

Going Through the Shops—II

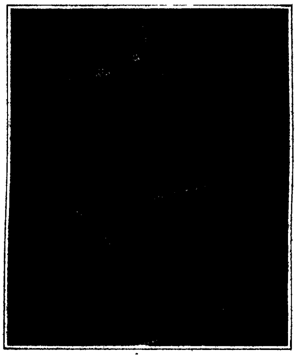
Our Associate Editor Sees How the Automobile Industry Has Stimulated Machine Tool Manufacture

By A. Russell Bond

FROM tinsmith to electrician, from wheelwright to upholsterer, a score of trades contribute to the manufacture of an automobile. It is almost too much to expect all these operations to be carried on in a single factory. The majority of motor car companies are content with the building of the motor and a few accessories, while some do not even do that, but purchase all the parts, including the motor, and in their own shop merely assemble them into complete automobiles. This is true even of high grade machines, for the parts, although manufactured outside are made according to the company's own blue-prints and specifications and under the eyes of their own inspectors. However, there are a few companies who make practically every part of the automobile in their own works, from the foundry and forge shop to the wheel and body building plant.

In this article we shall not attempt to describe the complete manufacture of automobiles, nor even single out any one branch of the work for detailed description, but we shall present merely a few scattered notes on interesting processes and machines that are to be found in the motor car factory.

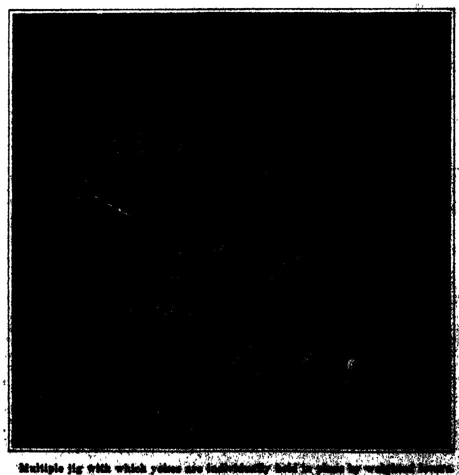
A visitor, particularly a layman who does not appreciate all the technical details of the machine shop, is sure to find the forge shop most entrancing; for man has not outgrown his primeval fascination for fire, and a sight of incandescent metal still throws a mesmeric spell over him. It is wonderful to watch the ponderous hammer of the drop forge, dancing over the work and periodically coming down with a light tap that deftly shapes the glowing metal or with a resounding crash as it cuts away superfluous parts. The intricate shapes that are turned out by these power hammers are marvelous. The three photographs at the top of this page show some interesting stages in the forging of a ring for a large bevel gear. A rectangular block of white-hot steel is taken out of the furnace and hammered in the forge until it takes the shape of a bulging body with rounded shanks at each end. The body is then flattened and placed over a die at one side of the anvil, where at the next blow a slot is all but cut through the middle of the body, so that it looks somewhat like a chain link, as shown in the first photograph. At the opposite side of the anvil there is a depression flanked by a semi-circular boss on which the link is rested. A similar semi-circular boss on the hammer head is intended to enter the depression, so that when it descends it strikes the link with a shearing motion, spreading it open into a ring, as shown in the other two illustrations. Of course, the process is more difficult, consumes more time, and is more expensive than casting the ring, but the result is much toughter steel, and, considering the use to which the part is to be put, it is well worth the additional cost.



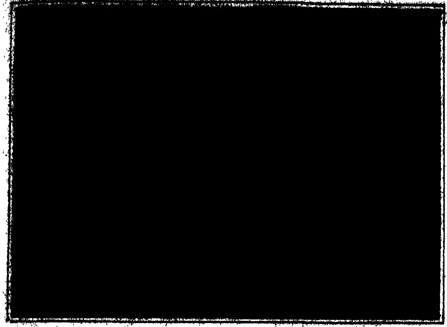
Mammoth press with which crowned fenders are formed.

Noisy as is the forge shop, it cannot compete in din and distracting confusion with the shop where sheet metal is hammered into various forms. Enormous steel presses cut out the fenders and body parts from sheet metal. One of our illustrations shows a large press stamping out a crowned fender. To this the side wings or aprons must be attached, and this is done by electric spot welding. Sheet aluminium is largely used in the building of the body. To bring this metal to the requisite contour it must be hammered. Some car

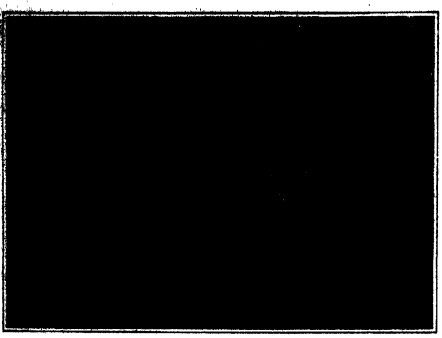
Milling two dozen spring hangers at one "set up."



Multiple jig with which yokes are individually held in place by [illegible]



An enormous multiple drill operating on a frame side-bar.



Battery of multiple drills which operate successively on a cylinder casting.

bodies are made of cast aluminium, instead of sheet metal secured to a wooden framing, and curiously enough the cast bodies are actually lighter than the sheet metal bodies, for the reason that they do not have to have as much bracing.

In the body plant one views with interest the application of paint to the metal parts by dipping, and also by spraying with an air brush. The latter operates like the artist's air brush. A stream of compressed air injects a fine spray of paint which may be laid on very evenly. Automobile manufacture is a young industry, but it has grown to be one of the biggest in the country, and has furnished a great stimulus to machine tool manufacture. In fact, it has grown so fast that the tool maker has had a struggle to keep pace with it. It is constantly demanding special machinery, not only to save hand labor, but to save machine labor; that is, multiple and gang machines which will co-operate to perform the work that previously required the use of a number of machines. It has developed new methods in setting up the work on the machine. It has produced jigs of most ingenious types to save time in setting up the work and to insure uniformity of product.

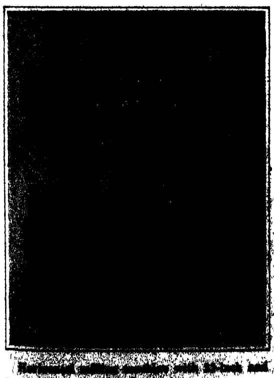
In last week's issue of the SCIENTIFIC AMERICAN we told of labor-saving methods employed in the manufacture of the low-priced car. This may have led some to believe that in the higher priced cars labor saving methods are not employed. Because the higher priced cars are usually turned out in smaller quantities, it does not pay to carry the labor saving methods to the extreme requisite in the manufacture of the low-priced cars. However, where a great many parts are to be duplicated, where a single casting is to have a great many holes bored in it, where a great many operations are to be carried on at the same time on a single piece of work, and where the various operations require simultaneous operation in order to obtain accuracy and uniformity, special jigs and machines are employed. One of our illustrations shows the milling of a large number of spring hangers. These are mounted on the machines in batches of two dozen, and four milling cutters operate on them at a time, so that the opposite faces of each arm of the fork are finished simultaneously, and they must bear the proper relation, one to the other. Another illustration shows a multiple jig, the feature of which is the automatic device that holds the steel forged yokes in place, to prevent them from springing while the arms of the yoke are being drilled. Before this device was invented, great difficulty was experienced in drilling the holes in the arms of the yokes, and keeping them in perfect alignment for the reason that the upper arm, being unsupported, would be sure to bend under the pressure of the drill. In this jig a division plate is placed between the two arms, and the yokes are held in position against a stop by means of weighted levers. The weights on the levers are shown in the foreground. Six yokes are drilled at a time, and by the use of this special jig 2,500 yokes may be turned out per day.

Multiple-spindle drills are very largely used in many lines of manufacture, but seldom does one find a machine as large as the one here illustrated. It is employed in drilling the holes in the frame side-bars of a certain type of car The machine extends the full length of the side-bar and consists of a gang of six multiple-spindle drill-heads, all of which operate simultaneously on the work. Three of these enormous machines are required to drill the holes in a single side-bar. One puts the holes in the top of the bar, another in the side, and the third in the bottom. These three machines with six operators and a sub-foreman will do as much work in a day as twelve single machines with twelve operators, formerly. But not only is time and labor saved by the employment of this multiple machine, but the workmanship has been carried to a finer degree of accuracy. Another illustration shows a battery of multiple drills arranged in line along a track upon which run the jigs that carry the cylinder castings. The jig is moved from drill to drill, and rapidly centered under each, until all the holes in the castings are bored.

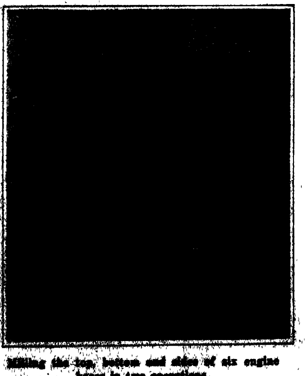
In last week's issue of the SCIENTIFIC AMERICAN we showed some horizontal milling machines operating on fifteen and thirty castings at a time. On this page we show a horizontal milling machine in which only four cylinders and crank cases are milled at a time. The machine is interesting however for the size of its milling cutters. The larger one is 22 inches and the smaller one 12 inches in diameter with inserted tooth cutters. After the work has been set up on the table it takes forty minutes for the revolving cutters to face off the opposite ends of the castings. Another milling machine, here shown, operates on six engine bases at a time, which pass between and beneath four large milling cutters, two of which are 15½ inches in diameter. In this machine the top and side of three engine bases are milled while the bottom and opposite sides of three more are being machined. The milling machine replaces four former machines and four operators. With two operators it can turn out 75 engine bases per day. However, the control of the machine

(Continued on page 66.)

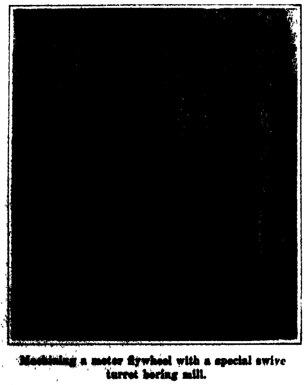
Special machine for recessing and facing a crank case and engine pan.



Horizontal milling machine with 22-inch and 12-inch cutters.



Milling the top, bottom and sides of six engine bases in two operations.



Machining a motor flywheel with a special swivel turret boring mill.

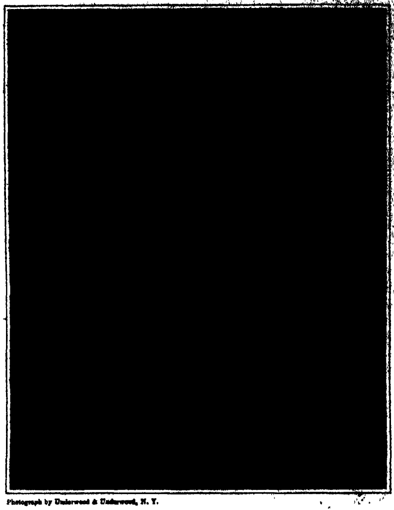
A New Mechanical Tunneling Machine

A Machine That Drills Into Rock, Loosens the Material and Removes It to Cars

FOR many years inventors have attempted to provide excavating machinery which would drill into the rock face of a heading, loosen the material and remove it to spoil cars at the rear of the machine for transport to some place of disposal outside. Many different forms of tunneling machines have been invented, but few, if any of them, have been able to stand up under hard work, largely on account of the effect of the rapid oscillation of their power drills and the constant jar and vibration of the entire machine. Furthermore, the continual renewal of the drills in all such machines has been an important and expensive item and has acted against their success.

In its issue of January 19th, 1909, the SCIENTIFIC AMERICAN described and illustrated a promising type of tunneling machine which powdered the rock by the direct impact of twenty-five piston drills mounted on a rotating head This machine had an extensive trial in service, but failed to meet the anticipations of its promoters. It was found that, like other tunneling machines, the fundamental principles of its design were faulty. The lack of success did not discourage the company which had developed the machine from further efforts in this field, and as a result of the efforts of Mr. Oliver O. App, the inventor, a new machine has been evolved on different lines which, for several months, has been under practical tests that are encouraging.

An experimental installation of this machine has been made at Marble Hill, 223rd Street and Broadway, New York city, where an open tunnel has been driven through the crystallized lime and quartz found at this point. With a full-sized machine, but with somewhat limited power, an effective demonstration of its working has been made, and a tunnel from 20 to 25 feet in length has been excavated through the extraordinarily hard rock there found.



Photograph by Underwood & Underwood, N. Y.

A tunnel borer that eats its way through rock, stone and sand.
Fifteen powerful rock-cutting pneumatic hammers strike over 1,000 blows each, with 25-pound hammers. A revolving disk carries the hammers.

The present machine consists of a rotary head carrying fifteen powerful pneumatic rock hammers which are directly in contact with the surface of the rock and revolve with the head. Instead of the piston type of rock drill used in the earlier machine, the new tunnel excavator employs drills of the hammer type chipping away the rock like the hammer and chisel of the stone cutter. The arrangement is such that the entire operation is automatically controlled and operated from the time of contact of the cutting tools against the face of the rock to the removal of the muck. It is here that the machine shows its superiority over other tunneling machines, for where the drills would operate whether there was any resistance or not, and in so doing would produce a very destructive vibration, in this machine the action takes place only when the cutting tool is directly against the rock, as the hammer does not strike the steel unless this condition is observed.

The construction of the machine will be seen from the illustration A revolving head carries the fifteen pneumatic drills, together with hydraulic jacks mounted at the upper part of two transverse diaphragms These jacks are secured into the roof and fix the position of the machine firmly in the excavation The head is moved against the surface of the rock to be excavated, and the drills, mounted on several holders, are individually and successively adjusted The machine itself is carried on wheels running on rails of standard gage, 4 feet 8½ inches, and its engine can be operated by compressed air, steam or electricity, air pressure being used in the present installation. As the main [illegible] revolves, the two screw jacks with a feed of [illegible] move the frame forward so that cutting tools [illegible] the rock and the speed of revolution of the head and the progress depend upon the nature of the material to be excavated. In soft material, such as shale, two revolutions per minute can be made, with progress of an inch per minute, or five feet an hour, while with very hard material, three, four or more minutes may be required for a single revolution. The center shaft carries the head and feeds forward the limiting distance of 3½ feet, after which the machine itself must be moved forward and set with the hydraulic jacks. Both the forward and rear diaphragms can be moved together or independently. The shaft itself is hollow, 12 inches in diameter with an 8-inch bore, from which compressed [illegible] rock is not cut but appears [illegible] as if it were lifted off in [illegible] concussion had [illegible]. In this way the common [illegible]ing to cut the rock is avoided, for it is realized that rock may cut steel quite as readily as steel will cut the rock. Consequently, when this excavating machine is put in adjustment the tools must be arranged so as to chip the rock. When the tools are in proper adjustment, each single tool must be set and locked.

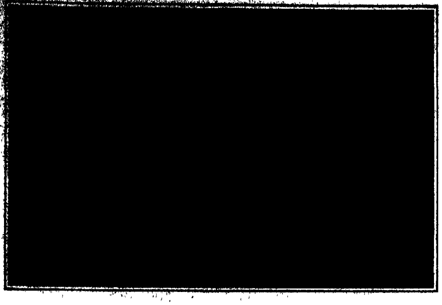
Photograph by Underwood & Underwood, N. Y.

The new tunneling machine.

The machine is so constructed that the cutting tools work only when they are against the [illegible] off automatically when its share of the work is done, allowing those with harder work to [illegible]. The action is similar to that of an auger boring through wood.

Researches at Kilauea

IN the November number of the *American Journal of Science* F. A. Perret publishes the seventh and last of a series of articles describing the remarkable investigations carried out at the crater of Kilauea, Hawaii, in the summer of 1911, through the co-operation of the Massachusetts Institute of Technology, the Carnegie Geophysical Laboratory, the Volcanic Research Society, and residents of Hawaii. A regular vulcanological observatory has since been established at Kilauea, and the investigations are still in progress. By means of a trolley, carried on a steel cable suspended over the crater, special thermometers were lowered into the liquid lava, which was found to have a temperature ranging from 1,050 deg. to 1,175 deg. Cent., though in virtue of its chemical activity the lava has the power of fusing metallic objects whose melting point is several hundred degrees above these temperatures. This paradoxical observation indicates that all estimates of the temperature of liquid lava based upon the melting therein of wires or strips of various metals are of practically no value. Samples of the molten lava were also collected by means of the trolley, and their subsequent examination led to some curious observations; e. g., that lava evolves much heat in solidifying, so that specimens maintained a stationary temperature for some three hours after being collected. A very important question, on account of its bearing upon the prevailing explanations of volcanic activity, is whether water of magmatic origin is found among the gases exhaled by active volcanoes. Its presence is denied by Dr. Albert Brun, who analyzed the lava specimens collected by Perret, but appears to be fully established by researches carried out in the summer of 1912, as reported by Drs. Day and Shepherd in the *Journal of the Washington Academy of Sciences* for November 4th, 1913. The later observers performed the brilliant exploit of descending into the crater and inserting a tube into the dome formed over a lava fountain, whence the gases were pumped into a number of collecting tubes. The latter were subsequently brought out of the crater, and the contained gases were analyzed. Considerable water was found to have condensed in all the tubes. Another notable discovery was that the nitrogen exhaled by the volcano contains no argon, and as the latter is always present in the atmosphere, it is concluded that the [illegible] does not contribute to the gases given off by the volcano. [illegible] water vapor, evidently originate entirely within the earth.



Twenty men seated about a table in an enormous locomotive firebox.

A [illegible]

THIS [illegible] shows [illegible]. This photograph was taken during the process of construction, and before the back head and flue sheet had been applied. There are twenty men seated about the table within the firebox. This is one of a lot of fireboxes now being built for the Philadelphia & Reading Railway, to be applied to their class I-8-A Consolidation locomotives. These locomotives are designed to burn anthracite coal, and hence the large grate area is requisite. These particular fireboxes will be built to form a combustion chamber between the bridge wall and the back flue sheet. The firebox consists of fifteen channel-shaped sections, each section being 20 inches wide over all. This firebox is 13 feet 2 inches long and 8 feet 8 inches wide inside dimensions. The distance from the bottom of the mud ring to the center of the crown on the inside is 5 feet 1 inch. It is expected that these fireboxes will be in service by next spring.

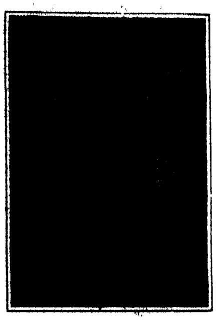
Brickwork Statuary

JUST as the Babylonians of old, on the Istar Gate of the Royal Castle, used to build up of glazed bricks their well-styled, imposing animal monuments, an attempt is being made to restore the brick to its ancient place of honor in modern statuary.

Instead of fixing a raw block in position and hewing it with the chisel, as is frequently done with the reliefs on English houses, thereby laying the brick open to atmospheric influences, and destroying the remarkably picturesque charm of the vivid colored material, the monument is molded bodily out of the unburnt brick clay, cut into layers and stones and each finished up carefully. In the kiln the molded parts are laid on a sand bed, insuring perfect mobility during the baking process and excluding any risk of breaking or bending. A perfectly uniform shrinking of 15 to 16 per cent may be accounted for. When the monument is next erected on the spot, the insertion of a proper thickness of lime-cement mortar into the joints between the brick layers restores it to the originally contemplated dimensions.

The accompanying photograph shows a figure intended for the monument of an African explorer to be erected in a German sea town. It is the joint work of a sculptor, Mr. Edzard of Paris, and Mr. Donandt.

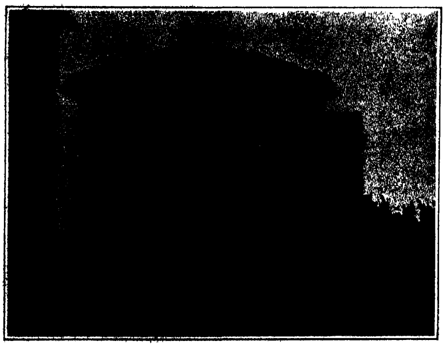
The monument, 33 feet high, grows out of a brickwork wall surrounding its base. The explorer, clad in his Moroccan burnouse, is shown astride on a camel, looking boldly out into the distance. This monument, rising above the river Weser, is to be a symbol of the spirit animating the seafaring population of the town which thus wished to commemorate the explorer.



A monument built of brick.

Up-to-date Corn Cribs

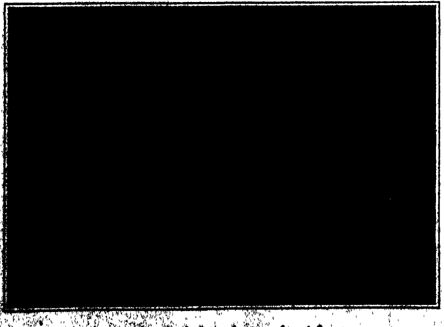
CORN cribs, like everything else, are liable to go out of date. The latest style is shown herewith. It is made of galvanized iron and concrete. It rests on the ground on a specially constructed circular concrete base which is guaranteed to make it absolutely mouse and rat proof and also weather-proof. It is an easy matter for the farmer to have his new style corn crib always full, for it is sectional like a sectional book-case, and therefore it may be enlarged or contracted to suit any crop. This one here illustrated was photographed at the Hamilton County Experimental Farm, near Mt. Healthy, Ohio, where several of them are in use.



Sectional corn crib that may be enlarged or contracted.

Clouds Formed Over a Forest Fire

IN the forest and brush fires which burned over many square miles in what is termed the "Back Country" north and east of San Diego this fall, an interesting phenomenon was observed on two occasions, when [illegible] were obtained by [illegible], of La Mesa, Cal., [illegible] as follows: "It occurred [illegible] on the 14th. The fire had been burning for several days despite the continuous efforts of hundreds of men working under the direction of the fire wardens, and had approached within from eight to twelve miles of La Mesa. Each time the phenomenon occurred on a clear, cloudless day. The first time as I watched the huge smoke columns filling the sky with their black pall, I noticed over one of the largest of the smoke columns a white cloud forming. It grew in size till it formed such a cloud as one frequently sees here hanging back over the mountains. A smaller one also began forming to the northwest of the larger one. The cloud was formed by condensation of the moisture driven up from the burning vegetation, and disappeared in a few moments. The phenomenon was repeated two days later, on the 16th, when a white cloud of peculiar beauty formed again over a heavy smoke column. It appeared like the snow-capped peak of some mountain; and resting as it did above the dense black smoke it presented a spectacle of striking picturesqueness, to which the accompanying picture does not do justice.



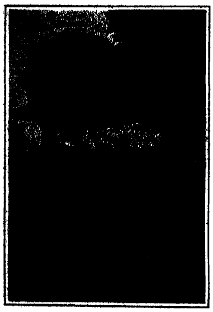
Cumulus clouds formed over a forest fire.

A Home-made Gasoline Tractor

IT occurred to a young Illinois farmer recently that he could make far better use of his three horse-power gasoline engine if he mounted it on wheels and converted it into a tractor. The photograph published herewith shows how the finished machine looked. The following is Mr. Everett Price's description of his machine and his method of constructing it· "By watching the 'Old Iron Man's' scrap pile different things were picked up and made use of. The hind wheels and axle are from a mower; the front wheels are gang plow wheels on an iron axle; the steering gear worm is from an old straw stacker and the hand wheel is a balance wheel to an ice-cream freezer. When running machinery using a tumbling rod, I use the jack shaft. Its ends are squared to fit an inch knuckle and it has a large belt pulley from a threshing machine keyed solid to it. It is run with a friction belt tightened by a lever and idler pulley. The pulley came from a corn planter reel, and the two levers from a gang plow. A second lever operates the traction gear. When lever is upright jack shaft runs free. When thrown forward engine moves forward, and when back engine backs. The bevel gears are from a mower and feed grinder. The pinions on the jack shaft are feathered. The large gear on axle is keyed solid, and axle is keyed solid to one wheel. It only drives from one side, but does not beat badly. The lever near the steering wheel operates the governor and sparker at same time. The speed ranging from 140 to 550 r.p.m. When I got the engine the speed was changed by a thumb-screw on top of the governor, and the sparker with a wrench, but by a few simple attachments both are changed together, giving a great range in speed.

"When traveling on the road, I travel about three miles an hour. I sit on a swinging spring seat, and have a foot-brake to use when going down hill.

"The tools I run are many and varied, such as band-saw, wood-turning lathe, disk sharpener, post drill, emery wheel stand carrying two wheels 2x12, sickle grinder, forge, two feed grinders, one for shelled and one for ear corn, two hole sheller and bucket elevators, sausage mill, pump, grain dump, cement mixer, wood-saw and anything else which can be run by belt or tumbling rod."



Home-made gasoline tractor.

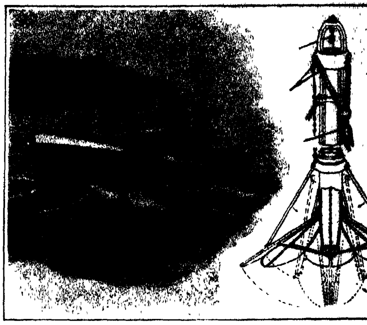
Glass-Filling Drinking Fountain.—A drinking fountain has been patented, No. 1,072,124, to Charles Edmund Kells, Jr., of New Orleans, La., which shows a drinking fountain in which a shield surrounds the discharge orifice from which the stream of water issues and passes through the shield without coming into contact with it. When the shield is adjusted to an inclined position the discharged stream may be received directly by the mouth of the drinker or may be used for filling a drinking glass.

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

Device for Releasing Stranded Vessels

THE accompanying illustration shows a device which has been patented by Mr. A. E. Luzzi, the object of which is to assist the wreckers in releasing a vessel which has stranded on a shoal or on the beach. It consists of a pair of stout, steel columns, whose principle of action is similar, on a large scale, to that by which a boatman poles himself off the beach, or by which the old Mississippi steamboats were wont to pull themselves off or across a shoal of the river. It consists essentially of the two columns, a system of chains which are slung beneath the vessel, and tackles and gear by which, through the hoisting winches, part of the load of the ship is transferred to the columns, and the operation of backing off the shoal is thereby assisted. The foot of each column consists of a folding base, consisting of a number of segments hinged together and also hinged to the base of the column, all in such a way that they can be opened out to provide a broad footing in sand or loose material, or closed up, as shown in dotted lines in our detail sketch, in order to afford a stiffer base of less area when they foot upon rock. When the base is open, it is supported against the column by a set of heavy steel rods, which extends from the outside of the leaves to a common sliding ring, which brings up against a fixed ring firmly attached to the column. A chain is run from the inner face of each segment and is attached to a common sliding block at the base of the column, which is drawn up or lowered by means of a chain, leading through to the center of the column. The vertical movement of the block serves to draw the segments into the closed position as shown by dotted lines. At the top of the column, which is extensible to suit the depth of the water and height of the ship, is a chain sling, and from this a block and tackle leads to the mast and affords a means for maintaining the columns in the desired position with regard to the ship. Heavy chains are passed around the hull abreast of the columns, and by means of heavy tackle, and the hoisting winches on deck or other suitable means of power, a heavy strain is placed upon the columns and a part of the load of the ship transferred to them. To ease the strain on the lifting gear when the ship is rolling, heavy coil steel springs are interposed between the base of the mast and the gear. By this means it is possible to transfer to the columns as much of the load of the ship as the columns will bear, and this lightening of the ship, coupled with the backing of the engine and the strain on the hawsers of the wrecking tugs is depended upon to release the ship and float her into deep water.



Device to assist in releasing stranded vessels.

The Eskimos as Aboriginal Inventors

By A. L. Kroeber, Curator of Anthropology, University of California

WINDOWS without glass, the carpenter's brace, the first decked boat, a type of self-supporting vault unknown to civilized architecture, an artificial arm, are only a few of the achievements to the credit of the Eskimo; while he has solved the problem of drilling a curved hole, or sawing without a saw, with ease. Twenty-five thousand to-day, perhaps fifty thousand all told before the diseases of civilization and alcohol had begun to draw them from the height of their prosperity, the Eskimo population from Greenland to Alaska has always been less than that of a second-rate city among ourselves It is not amiss to say that they have produced more inventive geniuses, man for man, than any other people, not excluding the Anglo-Saxon race.

With the exception of but a few tribes, they live in a climate where wood and all products of the vegetable kingdom are unknown, except perhaps for such small quantities as the ocean currents may drift to their shores. One half the mineral substances, including the all-important metals, are also beyond their reach in the ever frozen north; even if they mined iron ore, they would not have the fuel to smelt it. Only products of animal origin—bone, skin, hair, and ivory—stone, and the elemental substances ice, snow, and water, are at their service.

The snow-house well illustrates this. The Romans and their predecessors worked out the true arch and vault, and the Mayas of Yucatan used the false arch, but the Eskimo builds a spiral vault, which needs no scaffolding. The details of this construction in snow have been previously described in the SCIENTIFIC AMERICAN of May 7th, 1910, so it need not be gone into again here; but one of the remarkable features is that when the house is completed, the builder is immured inside. This, however, is of little moment, for his bone or ivory knife slashes out in a few moments a door big enough to crawl through.

Next comes the window, which is cut out just above the door. How does the aborigine make this without glass? Nothing easier. He has saved up a seal bladder, or walrus intestine, and this, by the application of a little water, or when that is not at hand, saliva, is deftly frozen in a few instants into its frame.

This window is translucent, like our frosted panes; it admits light, but not vision. Something transparent is needed so that the inmates can see whether the clouds are clearing, or friends approaching. A slab of smooth ice, broken out of a leather bucket of water set outdoors for a minute, is therefore inserted in a hole cut in the gut.

Now Mr. Inuk, as he would call himself, is ready to move his family into their new quarters. But half a day of warmth from five or six human bodies, not to mention one or two cooking lamps, will begin to melt the snow walls from the inside. The inmates would soon be exposed to an ever increasing icy drip, until the roof disappeared over their heads. A system of portieres, or better, wall hangings, remedies this problem. Ten or a dozen old seal skins are hung by bone pegs just below the inside of the wall, leaving a narrow but clear air-space between the interior of the little cabin and its snowy exterior. The cold penetrates to this film from the outside; the slender heat inside does not penetrate beyond the skins; and all difficulties are avoided.

So, in a few hours, man, wife, children, and perhaps dependant old people, are comfortably installed; and that in a structure which not only can teach the engineer of civilization a lesson, but is provided by this so-called savage, and was provided by his ancestors, with wall paper and window at a time when our ancestors sat shivering in bare walls as far away as possible from the open windows they could not close without being in darkness.

But our Arctic genius is still far from the end of his troubles. Where the temperature is forty below zero, artificial heat is needed even indoors; and where meat is frozen so hard that it cannot be butchered, but must be chopped like wood, cooking is at least desirable, however strong one's teeth. Iron for furnace or range is not available; coal and wood not to be had; petroleum not yet discovered in the Arctic.

A stove is clearly out of the question. The apparatus must be a lamp. The material, it appears, must be stone. For fuel, seal oil, tried out from fat and blubber, can be used; and a wick can be made from dry moss. So the Eskimo shapes a triangular piece of rock, slightly hollows out the top, lays his wick along one side, pours on his oil, lights up—or rather his wife does so—and soon the pot is boiling and the pure snow melting into clean ice water for drinking. Such is the origin of the first oil cookstove invented.

But before meat can be cooked, game must be caught. In summer this offers no great difficulties, even in the Arctic. But in winter, when land animals are hibernating in hidden places, when fish lie torpid deep under the ice, when birds have flown thousands of miles to the south, and when the great pall of snow and ice covers the world, the Eskimo faces a difficult problem. If it were not for the air-breathing sea animals of the seal and walrus class he would starve in short order. But the seal cannot be hunted like other game. He has the intelligence of quadrupeds, and therefore net and hook and line will not catch him like fish. On the other hand, he lives in the water, and if wounded by arrow or lance would make good his escape, to die, perhaps, under the ice or out at sea, but out of the hunter's reach. Even if killed at the first shot, he would immediately sink, for strange to say, his body is heavier than water. The Eskimo therefore needs a peculiar weapon. It must be effective from a distance; and it must not only wound, but hold the animal. The need for such an implement has resulted in the invention of

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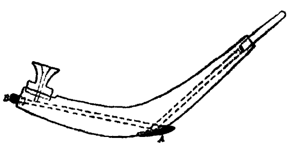
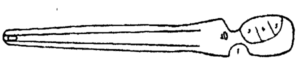


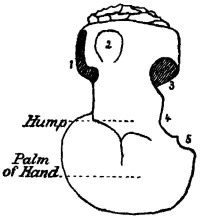
How the curved pipe is bored.

Note the detachable plugs *A* and *B*.



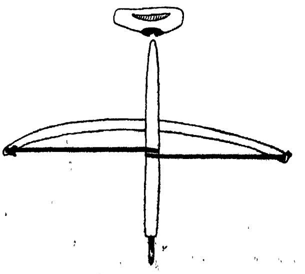
Left-handed spear thrower or artificial arm.

Finger depressions at 1, 2, 3, 4 and 5.



Woman's skin-scraper.

Thumb and finger positions indicated by numbers.



Carpenter's brace.

The mouthpiece has a stone socket-bearing and a groove for the teeth.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the Scientific American.

Pertaining to Apparel.

SEAM FOR SEWED ARTICLES.—J. Bas[illegible], [illegible] Howard Ave., Brooklyn, N. Y. This invention relates to a form of felling for edge seams of coats and other garments. It devises a method for securing together layers of cloth forming the edge of the garment in a way to make the felling almost invisible, while providing an edge seam felling that can be worked by machinery from the inside of the edge and finished with the same neatness as if felled by hand.

BUTTON.—A. R. Commerford and Susan E. Watrous, 53 Ayrault St., Newport, R. I. This invention has reference to improvements in buttons such as are attached to garments, and has for an object the production of a strong reliable button of neat appearance which is formed of cord, tape, or other suitable material.

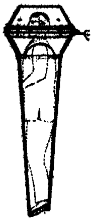
RING SETTING.—R. Rosenthal, 120 Chrystie St., New York, N. Y. The object here is to provide a structure for producing the same finish from the top of the setting downwardly through the ring. Also to provide an anchoring device and a deflecting device of the same kind as the fingers or prongs of the setting.

Pertaining to Aviation.

PARACHUTE.—A. Gokolak von Augeso, Baden near Vienna, Austria. This invention has for its object a mechanism for efficiently opening parachutes attached to persons or objects above the ground. Besides being a means of escape for aeronauts the device may be used as a fire escape in burning buildings, and serve for throwing up signal lights such as light balls, rockets or for firing projectiles from aeroplanes and balloons without subjecting the latter to recoil.

Of General Interest.

LIFE SAVING DEVICE.—E. E. Hills, Medina, Wis. The purpose here is to provide a container which will receive and hold a person upright in the water and protect such person from the water, floating wreckage and other conditions under which the usual form of life preservers would be unavailing. The container is of such a nature that the same with others may be conveniently stored on shipboard and readily and quickly placed in operation in case their use is required.


LIFE SAVING DEVICE.

FLOWER HOLDER.—W. S. Daniels, 872 Lexington Ave., New York, N. Y. This invention relates to flower holders for use in arranging and positioning flowers or the like in vases, bowls or other receptacles intended for their reception, and has reference more particularly to a device of this class which comprises a plurality of rods adapted to have the stems of flowers disposed among them to hold the flowers in place.

FLOWER HOLDER.

BUOYANCY TANK.—A. Erikson, Keith Estate, Babylon, N. Y. The tank comprises a hollow body having means for admitting air and water, and so designed that the pressure of the water upon the outside, no matter what the depth of submergence may be, is always balanced by the volume of air on the inside, so that it is impossible for the tank to be crushed under any conditions in raising sunken vessels and other submerged objects.

UMBRELLA.—J. W. Lewis, 134 Lower Terrace, San Francisco, Cal. This invention has for its object the provision of a simple and efficient means for detachably connecting the ribs and braces to the stick and runner respectively, wherein each connection is independent of the other connections.

SMELTING OR REFINING OF METALS AND THE LIKE IN CRUCIBLES.—H. G. Solomon, 4 Elgin Court, Elgin Ave., Maida Vale, London, England. This invention relates to induction furnaces applicable for crucible smelting and refining purposes. The object is to provide an improved form of induction furnace which shall be particularly, though not solely, applicable to the crucible process for making steel and steel alloys.

SECTION LINER.—B. Silverston, 22 E. 120th St., New York, N. Y. This improvement has reference more particularly to that class comprising a member having means to engage another member so as to form parallel lines in any desired direction and having any desired spacing between the said parallel lines.

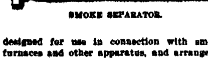
Hardware and Tools.

RAZOR GUARD.—W. L. King, 32 N. 9th St., Indiana, Pa. This attachment guards the cutting edge of the razor against accidentally cutting the face of the user, and the clamp element and the guard are so arranged, that the latter will exert a pressure against the clamp to bind the same against the razor blade.

WRENCH.—O. P. Case, care of A. W. Davis, Canandaigua, N. Y. In this case the invention is particularly adapted for embodiment in monkey wrenches and relates especially to novel means for holding the movable jaw of the wrench in adjusted position relative to the fixed jaw.

Heating and Lighting.

SMOKE SEPARATOR.—C. F. Holmes, 37 River Front, Beaumont, Tex. This inventor provides a new and improved smoke separator designed for use in connection with smelter furnaces and other apparatus, and arranged to effectively prevent poisonous or obnoxious gases from passing into the atmosphere, at the same time retaining and saving valuable matter contained in the smoke.


SMOKE SEPARATOR.

SOLAR HEATING APPARATUS.—M. de la Garza, 408 S. Campbell St., El Paso, Tex. This invention provides an improved lens, and improved means for adjusting the frame carrying the lens, lens tube, and a casing to contain a heater or other apparatus. It is designed more particularly as an improvement on the apparatus forming the subject of U. S. Letters Patent, No. 696,326, formerly granted to Mr. de la Garza, although features of the present invention are not limited for use with the patented apparatus referred to.

FEED WATER HEATER AND PURIFIER.—T. O. Organ, 116 W. Seymour St., Philadelphia, Pa. The heater is provided with an oil separator having an inlet for impure steam and an outlet for purified steam, said outlet being located in the wall of the separator opposite the inlet, and provided with a flange projecting toward the inlet and an oil outlet forward of the steam outlet, a chest, the inlet of which is formed by the purified steam outlet of the separator. The chest has an outlet to the heater's interior, and a valve in the chest and controlling its outlet. The invention relates more particularly to the one disclosed in Letters Patent of the U. S., No. 781,453, formerly granted to Mr. Organ.

Household Utilities.

FLUSHING DEVICE.—N. J. Gondolf, 708 State St., New Orleans, La. This invention is intended for flushing tanks having a siphon, and a siphon starter that supplies a jet to the shorter leg of the siphon to start the action. It provides actuating devices for the valve means that command the water inlet, so arranged that the opening of the valve to start the siphon will be accomplished without submerging the ball float.

COLLAPSIBLE WARDROBE.—J. A. Hazzard and A. B. Jones, 1 Emily St., Cambridge, Mass. This dust-proof compartment can be suspended in any desired place, can be easily collapsed to a compact package of convenient size for transportation and the parts are so interconnected that none can get lost. The parts constituting the wardrobe may be quickly and securely assembled to form a dust-proof compartment.

BEDSTEAD KNOB.—S. J. Fletcher, Shepherd St., Ashfield, New South Wales, Australia. The object of the present invention is to effect certain improvements in bedstead knobs whereby the latter are supported more firmly, the provision of the screwed nut in the knob is obviated and the adjustment or removal of the knob may be more quickly effected.

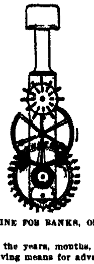
WINDOW WASHER.—G. D. Giovanni, 450 E. 151st St., New York, N. Y. This invention refers to improvements in window washers, and has for an object to provide an improved structure which may be adjusted in position and then operated until the window to which it is connected has been thoroughly cleaned.

Machines and Mechanical Devices.

FLASH MACHINE.—J. L. Courson, Barberton, Ohio. This inventor provides a construction which includes a number of receptacles receiving the materials for producing the flash, together with suitable mechanism for causing the materials in each receptacle to be ignited in turn in a positive manner when the camera shutter is thrown open to make the exposure for the picture that is to be photographed.

FABRIC FOLDING DEVICE.—H. S. Burnham, Lawtons, N. Y. This invention relates to fabric folding devices for use with sewing machines and the like, and has reference more particularly to a device of this class, which includes continuously movable means for rolling under the edge of a fabric to form a hem.

DATING MACHINE.—E. E. Gregory, Central City, Ky. Mr. Gregory's invention relates to dating machines, particularly for use in banks, real estate and loan offices, and more particularly to an apparatus embodying stamping wheels for the years, months, and days of the months, having means for advancing a pre determined number of days through a single actuation of a certain portion of the machine for this purpose.


DATING MACHINE FOR BANKS, OFFICES, ETC.

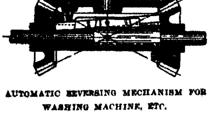
TRANSMISSION GEARING.—J. Chalmers, 60 Edison St., Quincy, Mass. The object in this instance is the provision of an improved structure in which power may be transmitted from one shaft to another through a plurality of gearing designed to change the ratio of rotation at the will of the operator

AUTOMATIC CHUCK—D W Wood, care of McNutt & Shattuck, 12 G A Knight Block, Brazil, Ind This invention relates particularly to a holder to be used on turret lathes, screw machines, or wherever an automatic chuck with a changeable collet is desired. By this invention the engagement of the hood with the spindle may be disalined or worn out without in any way affecting the alinement of the collet itself.

CAMERA.—A Voris, 15 Cottage St., Jersey City, N J. This invention relates particularly to devices having a reflecting mirror and a focusing plate, which will permit the operator to view a full-sized image The apparatus is foldable in compact casing when not in use, and may be unfolded or extended for taking a comparatively large negative

BOX MAKING MACHINE—G M Westland, 802-804 Main St, Winnipeg, Canada This invention provides a holder with means for indicating the proper place of the parts of the box and for holding such parts in place and so arranged that while the holder is firmly held in place on the support, yet it may be changed in position to bring the work into the successive various positions necessary for the different operations.

AUTOMATIC REVERSING MECHANISM.—T. H. Phillips, Jr., 38 Ridgewood Ave., Brooklyn, N. Y. The invention depends on the ratio of gears to cause automatic reversal of a driven shaft at any predetermined number of revolutions or with a fraction thereof. The mechanism can be used on washing machines, churns and topping machines. There are no cam wheels, dogs and ratchets, star wheels, sliding clutches or keyways or step by step operations to cause reversal.


AUTOMATIC REVERSING MECHANISM FOR WASHING MACHINE, ETC.

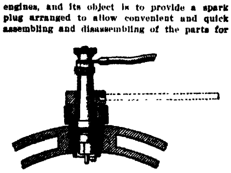
FIRE ESCAPE.—H. Croteau, 23 Villeneuve St., Montreal, Canada. This invention is so constructed that it requires but little power to operate the same, and is preferably in the form of an endless carrier moving over pulley wheels at the top and bottom, and being provided with rungs on which the persons escaping from the building can support themselves.

PACKING MACHINE.—J. Hochenauer, 2616 Grand Ave., Pueblo, Colo. This invention has reference to packing machines and more particularly to a double packing machine, the object being to provide simple attachments for actuating two packers in unison, doing away with all friction and other clutches and adapting the packers to run continuously.

FRICTION GEARING—C. N Whipple, 1019 Nora Ave., Spokane, Wash. The purpose here is to provide a device wherein means is provided for connecting a driving and a driven shaft by means of which the relative speed of the shafts may be varied without stopping or slowing either, and without any danger of breakage, stripping gears or the like.

Prime Movers and Their Accessories.

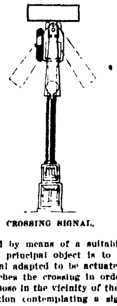
SPARK PLUG—J. J. Meyer, Yonkers, N Y. This invention relates to internal combustion engines, and its object is to provide a spark plug arranged to allow convenient and quick assembling and disassembling of the parts for removal of the electrodes for cleaning, repairing or other purposes, and to protect the assembled parts against injury by vibration or jars incident to the running of the engine.


SPARK PLUG.

Railways and Their Accessories

CAR COUPLING—H R Swan, 938 Fifth Ave., Huntington, W. Va The object here is to provide an arrangement of structure whereby a gravity latch member may be utilized upon the tail of the knuckle and the parts moved toward and from the closed position without the destructive friction between the knuckle parts and the drawhead which is usually present in such arrangements to the detriment of all the parts

CROSSING SIGNAL—W. A. Hesse, Alameda, Cal This invention is particularly directed to mechanism adapted to be actuated by a train approaching the crossing, the control being effected by means of a suitable electric circuit The principal object is to provide a crossing signal adapted to be actuated when a train approaches the crossing in order to give warning to those in the vicinity of the crossing, the construction contemplating a signal characterized by an oscillating arm.


CROSSING SIGNAL.

Pertaining to Recreation.

AUTOMATIC FISH HOOK—F Forester, 124 Second St, Elizabeth, N J. This device has connected thereto pivotally a plurality of individual fish hooks and also has means whereby when one of said hooks is struck by a fish, a pull upon the line will cause the other of said hooks to become operative or to increase its catching tendency.

Note.—Copies of any of these patents will be furnished by the Scientific American for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper

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We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

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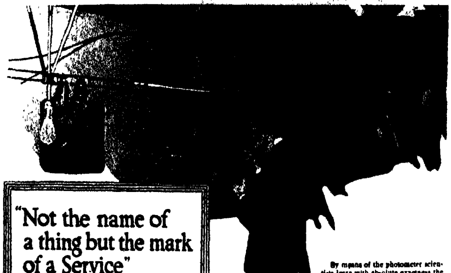
The meaning of MAZDA

Talks about MAZDA—No. 1



By means of the photometer scientists learn with absolute exactness the candle power of an experimental lamp, watching always for any indication of possible advance in lighting economy

"Not the name of a thing but the mark of a Service"

A SINGLE glimpse into that exceedingly busy place, the Research Laboratories of the General Electric Company, at Schenectady, would convince any spectator that science does not consider the great world problem of artificial lighting as having been finally solved. This headquarters of electric lamp science hums with an activity that not only tells the story of great things done, but that tells also the story of constant, vigilant, unremitting effort toward still higher achievement

But the fact about these laboratories that is of greatest significance to every user of electric light is the big plan and purpose behind these endless tests and experiments that are illuminating the path of further progress.

This big plan is expressed in the word Service. And the sign of this Service, the trade-mark of this maintained effort, this good will of a scientific movement, is "MAZDA"

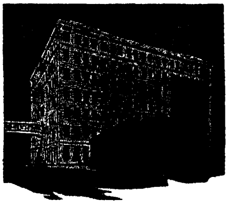
Every one of these tests, every laborious detail of these experiments—in glass, in filament wire, in "anchors," in chemical actions and reactions, in endurance, in economies of current, in practical use and facilities of manufacture—is telling the story of this Service, is giving to that Service trade-mark "MAZDA" the inspiration of a watchword.

The sustained brain-power of this Service—made visible day by day, month by month and year by year in the "MAZDA" lamp—has been creating lamp history. When the discovery of the availability of certain rare metals for lamp filaments, such as tantalum and tungsten, dethroned all earlier types of incandescent lamp, the new elements brought new mechanical and electrical problems The early tungsten filaments for example, while far excelling the filaments developed from other metals, were too fragile fully to meet the strain of the harsher uses to which lamps are subjected

It was in these Research Laboratories that these problems were worked out, and a method discovered by which the fragile tungsten paste filament was superseded by a strong drawn wire filament which not only gives *three times* as much light as the old style carbon lamps with the same amount of current, but is staunch enough to meet all the demands of modern usage. It is in these Research Laboratories that the step by step progress toward ideal light has attained other advances in construction, other increases in economy, by which the lamp of today that bears the mark "MAZDA" became possible.

To *carry forward* the work that has safeguarded the leadership of the "MAZDA" lamp, the distinguished corps of technical experts behind this Scientific Service is not only maintaining, without intermission, vast original investigation and experiment at this focal point of electrical science, but is keeping in touch with the great experimental laboratories of Europe.

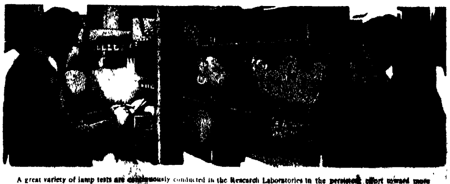
And "MAZDA" means more than the gathering of these products of scientific labor. The "MAZDA" Service plan means also that the laboratory experts at Schenectady keep equally in touch with the General Electric Company factories and the factories of other companies entitled to receive "MAZDA" Service, giving to each of these manufacturing centers every new fragment of knowledge which the skill of the Research Laboratories has selected as of practical application to the "MAZDA" lamp.



New building of the G-E Research Laboratories at Schenectady, headquarters for the scientific effort known as "MAZDA" Service. This service comprises constant experimentation and world-wide investigation, so that the mark "MAZDA" on an electric lamp shall always signify the latest achievement in metal filament lighting by the ablest lamp experts in the world.

Thus every lamp that bears the name "MAZDA" indicates that this Service has been applied to the production of that lamp. This is your assurance when you buy a "MAZDA" lamp—whether you buy it today, or tomorrow, or next month or at any future time—that you have the metal filament electric lamp that sums up the latest successes of the ablest lamp experts in the world.

GENERAL ELECTRIC COMPANY



A great variety of lamp tests are continuously conducted in the Research Laboratories in the persistent effort toward more and more efficient lighting, and demonstrated advances in this science are transmitted to the manufacturing centers entitled to receive this "MAZDA" Service.

4603

Protecting East St. Louis Against Floods

(Concluded from page 44.)

will work its way southward, filling the river between the new shore line and the levee for a distance of three miles.

The levee wall in front of East St. Louis is for a considerable distance about ten feet higher than the street level, while the Mississippi River at low stage is considerably lower than the street level. It would be an unnecessary waste of energy to drive the teams and trucks over the top of the levee wall and then down over the wharf to the boats, so the engineers constructed the levee to suit the conditions prevailing at the high and low stages of the river. When the river is at low stage the teams are allowed to pass directly from the street level on inclosed inclined planes running parallel to the levee wall through openings in the main levee wall. At the top of the inclosed inclined planes flood gates have been built. When the Mississippi River is high these flood gates are closed, and the teams pass over the levee wall by way of other inclined planes. This scheme enables the teams to reach the boats conveniently during high and low water.

Moving south we find the Cahokia Creek flood gates. These are operated on the same principle as the smaller gates we saw farther north. They hang vertically and the pressure of the water from the Cahokia Creek opens them. When the Mississippi River is high its pressure keeps them closed. South of Cahokia Creek the levee is the same as it is north of Madison.

Going Through the Shops

(Concluded from page 51.)

does not take all of their time, for they also run a grinding machine which grinds the top of each crank case where the cylinders fit on. A similar machine is used for milling both ends of the engine base at one set-up. Two special fixtures carry eight front supports and eight rear supports and enable one operator to turn out eighty pairs per day, whereas, formerly, four machines and four operators were required to do this work.

A special boring machine used for retouching and finishing the rear end of a crank case and engine pan is shown herewith. A double-ended star feed mechanism is mounted on rigid spindles. One set of cutters squares off the end of the crank case to the correct length, another set recesses it to proper depth to receive the forward end of the transmission piece, all of which is done automatically. Our last illustration shows a special boring machine operating on a flywheel. In the swivel turret head are two pairs of tools for machining the edge inner face of the wheel while still another tool operates on the outer face.

These fragmentary notes will give but a fleeting impression of the countless labor saving appliances and processes employed in a motor car factory. Lest one may gain the impression that labor is saved at the expense of accuracy we shall describe in the next installment the rigid tests which various parts, as well as the completed engine, must undergo in the high grade factory.

Aboriginal Inventors—the Eskimo

(Concluded from page 44.)

the harpoon, which the Eskimos have perfected beyond all other nations.

The harpoon is a lance with a long line attached. This rope, made of the skin of previously killed walruses, is, however, fastened not to the harpoon itself, but to its point. This point, or toggle-head, is detachable. While the missile is in flight, or penetrating the victim's body, the head is end on, presenting its sharp point. Once in the body of the seal, the head comes loose, turns broadside, and is prevented by this position, as well as its barbs, from being pulled out. The shaft, or harpoon itself, comes out, floats on the surface, or hangs free from the line. On the other end of this line, however, is Mr. Eskimo, holding on with a death-like grip. If he is hauling [illegible] for miles, [illegible] hauls it closer and [illegible] breathe, another harpoon [illegible] is plunged into it until it expires. And then not only he, but his family and their friends, have plenty for some days.

This sounds easy, but the Eskimo knows better. The seal has the keenest of scent and hearing, and is difficult to approach closely. On the other hand, the Eskimo's harpoon, if big enough to hold a large animal, is heavy, and can be thrown only a short distance. If the Eskimo were twice as big as he is, he could throw twice as far. If only his arm were double length, he could hurl double the distance. But he is a stumpy fellow, muscular indeed, but short limbed. Well, what does this surprising individual do but make himself an artificial arm, which lengthens his natural limb by fifty per cent!

The "spear-thrower" is what this apparatus has been called; but it is indeed an artificial limb. Even the most skeptical become convinced when they can see and feel the grips for each finger. A large groove in one edge exactly accommodates the thumb. In the other edge is a depression, or rather a series of three, into which the three last fingers of the hand fit neatly. The index finger has a hole all for itself on the under side, to give a good grip; this hole is just carried through, so that the nail of this finger coming from below almost meets the thumb.

The remainder of the implement is simple, consisting of a long, grooved extension, into which the butt of the harpoon fits, being held at the end by an ivory hook or peg. From this peg the spear is really propelled. As the "thrower" rises into the air with the arm, the spear is released by the clutching fingers, until, when the implement is vertical, the harpoon flies forward.

The increased effect of the "thrower" is also easily calculated. Assuming that it is sixteen inches long, it adds one half to the length of the arm. Now the arm forms the radius of a circle, or part circle, in which the extremity moves that propels the spear. If the radius is lengthened by half, this circle is increased by half. The spear covers this enlarged distance in the same time as it would if held in the unequipped hand; hence its velocity is half as great again. The velocity being higher, the distance traversed by the missile will be greater. Hence the implement adding fifty per cent to the length of the natural arm, adds also fifty per cent to the range of the Eskimo's harpoon, and more than doubles his chance of striking the game.

The same patience and ingenuity are displayed in carving out ivory handles for the stone-bladed knives which the Eskimo woman uses for scraping skins. Each finger, and even the palm of the hand, has its particular notch or exactly fitting depression, so that every part of the hand may obtain a firm grip and every ounce of effort be utilized.

With all the work she does, the Eskimo woman's hand remains small and delicate. Her scraper will only fit a lady's hand. A man, Eskimo or white, can no more properly grasp her tool than he could put his foot into Cinderella's slipper.

The scraper, as well as the spear-thrower, is of course carved individually to fit a particular person's hand. This enables one to tell at a glance whether the man or woman who owned it was right or left handed. Ninety-nine per cent of the implements for either sex are for right-handed people. Evidently right-handedness is not a product of effete civilization and school training, as we are apt to think, but goes back to savagery.

Though no tobacco grows in his land, the Eskimo dearly loves to smoke. Strange to say, while inhabiting a part of that continent which first gave tobacco to the world, the Eskimo uses a pipe of Asiatic type and origin, as shown by its small steep bowl and curved stem. How to bore a hole around the corner in this stem is no trick at all for our Eskimo. He drills from both ends and [illegible] holes at the middle of the stem, where [illegible] meet [illegible]. When the [illegible]

LEGAL NOTICES

PATENTS

If [illegible]

All [illegible] TRADE MARKS FOREIGN PATENTS, etc.

All patents secured through us are described without cost to the patentee in the SCIENTIFIC AMERICAN.

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Advertising in this column is 75 cents a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

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WANTED—One person each locality as agent for [illegible] Hiller Mop Co., 1385 Grand Ave., Chicago, U. S. A.

VACUUM CLEANER AGENTS. Absolutely new design in [illegible] powerful bellows vacuum cleaner [illegible] at $7.50. Write for particulars about [illegible] now. [illegible] Company, Box 909, Dayton, Ohio.

HELP WANTED

MINING and manuf. corporation needs young, ambitious [illegible], commercially able and technically educated, who can command $10,000 to help expand development. Can realize great profits from secured investment with liberal salary. A rare chance. Address, Box 483, Little Rock, Arkansas.

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A PATENT on an improved lock and key for sale. Interested parties can obtain full particulars by addressing A. Sutter, One hundred and eighty [illegible] Ave., Union Hill, New Jersey.

PATENT FOR SALE. Sanitary back washing accessory. No competition on market. Good house to house canvas. For further particulars address [illegible], Box 485, Kalispell, Mont.

INQUIRY COLUMN

READ THIS COLUMN CAREFULLY. You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. In every case it is necessary to give the number of the inquiry. Where manufacturers do not respond promptly the inquiry may be repeated.
MUNN & Co., Inc.

Inquiry No. 9346. Wanted the name and address of parties manufacturing tobacco stripping machines, and other machines pertaining to cigar manufacturing and cigar banding machines.

Inquiry No. 9347. Wanted the name and address of an industrial school where dressmaking is taught in all its branches.

Inquiry No. 9348. Wanted the name and address of manufacturers having useful household necessities, with a view to obtaining exclusive territory for a house to house canvass.

Inquiry No. 9349. Wanted the names and addresses of the makers of machinery for making Malt Tonic, also a machine for making grease, and machines for applying plaster (Cement Gun).

Inquiry No. 9350. Wanted the name and address of the manufacturer of a printing press for the printing of [illegible]. The machine should preferably be worked by hand.

Inquiry No. 9351. Wanted to make some article out of wood which could be made from 1 inch [illegible], by party having 75,000 or more feet of waste per year which is now used for fuel.

Inquiry No. 9352. Wanted the name and address of a person who is in a position to get the state or county agency for articles of merit that can be sold to business houses or others at $5.00 or over. No kitchen utensils desired.

Inquiry No. 9353. Wanted the name and address of a manufacturer who can make flexible oil cans.

Inquiry No. 9354. Wanted the name and address of a manufacturer of a machine which will stitch silk around small metal rings.

Inquiry No. 9355. Wanted the name and address of the maker of triplex glass.

Inquiry No. 9356. Wanted the name and address of a manufacturer who can build an automobile wheel, also a cigar banding machine. Concerns in the middle West preferred.

DO YOU KNOW WHAT'S DOING IN YOUR OWN BUSINESS?

[illegible]

The Lectern(?) Patent Insurance Co. Ltd. is prepared to supply regularly to manufacturers, [illegible] or other interested parties, exclusive information concerning the latest patents and developments in any particular branch of commerce or industry, especially valuable to manufacturers outside the British Isles.

[illegible]

[illegible] sides of a mouthpiece, all the openings but one are neatly closed with [illegible] plugs, and a single airchannel extends from bowl to mouth-piece.

The drill with which this work is done is as ingenious as our best carpenter's braces, though simpler in construction. The bit is a stick with a hard sharp-pointed stone set in the end. It is turned by a string looped around it. The ends of the string are knotted to a curved ivory bow. When the workman fiddles this back and forth, the string of course moves with it, and the drill is twirled. To hold it up and steady, a snug socket is set on the top; and the oval piece that contains the socket is shaped to fit—the mouth. Thus the workman grasps it with his teeth, leaving one hand free for the operation of the bow, and the other for holding or manipulating his material. So in this device there is truly the origin of the carpenter's brace, just as Eskimo tools and appliances always evince the height of aboriginal inventive power.

Smut Diseases and the Threshing Machine

THAT the threshing machine is one of the principal means of spreading smut diseases in grain is emphasized in a recent article by H. T. Güssow, Dominion botanist of Canada. A machine that has been used for threshing smutted grain is so fully infested with spores that any grain subsequently threshed, unless the machine is properly sterilized after use, will become liable to infection. Moreover, in traveling from one farm to another the infested machine scatters spores along its route. Dr. Güssow urges the enactment of legislation against this evil analogous to that already in force in some provinces of Canada against the spreading of weed seeds by threshing machines. The laws requiring that the machines be swept free from seeds after use should also require thorough disinfection, which may be readily carried out by inclosing bags or sacking soaked in formalin solution in the machine for a few hours, and spraying the exterior parts and implements with the same solution.

Maize Sugar

MR. O. W. BARRETT, the versatile horticulturist of the Philippine Bureau of Agriculture, takes a hopeful view of the possibility of maize becoming a serious rival of cane in the sugar market, and advises Philippine planters to experiment along this line, notwithstanding the unsatisfactory results of experiments already conducted in the United States. The maize plant, when deprived of the ears at the time starch is being deposited in the kernels, i. e., when the seed is "in the milk," develops a remarkable saccharose, or rather glucose content. Thus, the agricultural chemist of the Rhodesian government finds as high as 12½ to 14 per cent of sugar and about 1 per cent of glucose in the decobbed maize stalks in his experiments, which is above the average yield from sugar cane. Mr. Barrett quotes the opinion of experts that maize "will be, through its wonderful variability under the hybridizer's hands and its adaptation to man's varied needs, the greatest crop of the future."

How to Make a Measurer of Liquids

A VERY simple method for making a container for liquids which measures off say a quart at each time the liquid is poured, is to take a large cylindical can and put in a false bottom which holds about a quart between this and the bottom of the vessel. At one side of the false bottom is an opening which connects with the main body of the can, and on the other a tube leading to the mouth of the vessel, so that the mouth connects in reality only with the before mentioned space. This space being filled with the liquid, we tilt the can down so as to keep the level in the main chamber below the orifice and prevent further entry to bottom chamber, so that the bottom chamber now holds just one quart and can be emptied at the mouth of the can.

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There are on file with the owners of Sanatogen no less than 18,000 letters from practicing physicians praising, endorsing Sanatogen. Truly, a magnificent monument to the value of this food-tonic.

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Col. Henry Watterson, the famous Editor, writes:

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Prof. C. A. Ewald, of Berlin University, Doctor honoris causa University of Maryland, states in his contribution on "Typhus abdominalis":

"I can say that I have used Sanatogen in a great number of cases (that is, in those disturbances of metabolism which were mainly of a nervous or neurasthenic origin) and have obtained excellent results."

Charles D. Sigsbee, Rear Admiral, U. S. Navy writes:

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Notes and Queries

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(12899) O. O. B. G. asks: 1. What force is it that causes a pendulum to swing up after it has fallen through an arc? The point of dispute is, one maintains that it is momentum, and the other says that it is inertia. Of course, the relation of the two is very close. A. Momentum is the force which carries a pendulum along its swing. Inertia is not a force. It is a property of matter. It expresses the inability of matter to move or stop itself. That is all there is to inertia, simple inability. Momentum is a force. It is measured by the product of weight by velocity. 2. Why is steel used to make springs instead of copper, or preferably to that metal? One party maintains that it is because the elasticity of the steel is greater, and the other maintains that it is because the tenacity of steel is greater. Also he (the latter) asks why, if the first is correct, that rubber is not used preferably to either of the others because it is most elastic of all substances. A. Steel is used for springs because it is both elastic and strong. Copper has very little elasticity, and little strength, or tenacity. Rubber is used for such springs as it is adapted to. It has a wide range of elasticity, and will stretch much farther than steel, but its elasticity is soon lost. Its elasticity of compression and stretching is valuable, but not its elasticity of bending. The elasticity of bending in steel is most valuable. Rubber is not the most perfectly elastic of all substances. Steel and glass are more perfectly elastic than rubber. Both retain their elasticity for many years, even indefinitely.

(12900) H. M. S. asks: Can you give me a formula for making bright red prints from photographic negatives by the ferro-prussiate process? A. A process for making red prints from prussiate paper is given in our "Cyclopedia of Formulas," page 701, price $5. "Float the paper 4 minutes on a bath of nitrate of uranium (not strong) drain, and dry. Expose under a negative for 8 to 10 minutes. Wash, and immerse in a bath of ferricyanide of potash, 30 grammes, water 3 ounces. When the print is red it is fixed in running water." You will find many processes for different tones in this valuable cyclopedia.

(12901) R. O. U. asks: Can you give me any information as to whether at any time there has been manufactured and sold a ball nozzle on which the ball was loosely laid in the cup of an ordinary nozzle, so that it would fall out if the nozzle were not held almost exactly upright, but when the water was turned on, it threw a very fine film of water without throwing the ball away? This seems to me a preposterous statement as I make it, yet several friends have vouched for it, claiming to have seen it in action, although the only ones that we could find in the hardware stores or at home had the ball O. K. but had a wire loop to keep it in position. A. The ball nozzle acts just as you describe it, although it seems strange at first thought that it should do so. The wire loop which is put across the mouth of the nozzle to hold the ball, is to hold it in place when the water is not turned on. As soon as the pressure of the water comes, the ball is forced in hard against the water and cannot fly away. The pressure of the air holds it against the water, and the water is spread in a spray over a very wide space. The explanation is very simple. You will find it in Hopkins, "Experimental Science," vol. 1, page 90, as the Ball Experiment. The ball forces the water to spread out as it issues from the nozzle, and thus the pressure is reduced below that of the air, and the air presses the ball into the cup of the nozzle.

(12902) A. Y. B. asks: Can a vessel be made of any other matter outside of glass that can retain a vacuum permanently? A. Any vessel of metal which is strong enough to withstand a pressure of 15 pounds per square inch may be used for vacuum purposes. It will hold a vacuum indefinitely, if the valves are made airtight at that pressure. The carbon dioxide cylinders and the oxygen and gas cylinders for the calcium light hold several hundred pounds of pressure for many months with very little leakage. They are of steel.

(12903) T. G. asks: Wishing to magnetise (permanently) a steel bar about 10 inches in length, I have wound nearly its entire length with twelve layers of No. 12, insulated, copper wire. There is a dynamo here, with a direct, maximum current of 2,500 volts. Now will you kindly favor me with a reply to the following: 1. Will it be sufficient to connect the ends of the coil, each with one of the poles of the dynamo? A. It will not be enough to connect your coil with one pole of a dynamo. No current can flow through a wire unless both ends of it are connected to the circuit, at points which are at a different potential or voltage. 2. Will a current of 2,500 volts be too strong for No. 12 wire, and should, therefore, a current of lower voltage be used? A. It will not be safe to connect your wire to the two poles of a 2,500 volt machine. The wire would be melted in a few seconds. 3. The manager of our local electric light plant says that on the loose ends of the wire, between the connection with the poles of the dynamo and the coil, one or more electric light bulbs must be affixed. Is that really necessary? A. You should have as many lamps less one as there would be placed in series for ordinary lighting. Let the coil be put in where one lamp would be put, and it will probably not overheat, and the current will magnetise the steel bar. 4. I have read that the magnetic or electric current does not affect the entire body of a wire or a bar of steel, but affects the metal only upon the surface and to a small depth below the surface. If this is true, will not a steel tube, with an inner diameter of 1 inch and a wall of 1-8 inch, containing three separate inner tubes (concentric), each also with a 1-8 inch wall, and each of the tubes magnetised separately, have far more magnetic (i. e. attractive) power than a solid steel bar of 1¼ inch diameter and of the same length. A. A magnet made of a number of thin pieces of steel is usually stronger than one made of a thick bar of the same weight. Probably steel tubes can be magnetised and fitted together so as to make a stronger magnet than a solid bar of the same weight.

(12904) C. E. O. asks: I write to you for information concerning the year 1900. Was it a leap year? And if not, please send me a Scientific American Supplement explaining why it was not. Some say it was, and some say not. Please send also a list of all your Scientific American Supplements and Catalog of Scientific Works. A. The year 1900 was not a leap year, neither was 1800, nor 1700, but 1600 was, and 2000 will be a leap year. The ordinary year is 365 days 5 hours 48 minutes and nearly 46 seconds long. If one day is inserted every 4 years, which is 6 hours a year, this is too much by 11 minutes and 14 seconds, and by dropping the extra day three times in 400 years the calendar will be kept very nearly with the sun for many centuries. This was discovered by Pope Gregory XIII, and this calendar is for that reason called the Gregorian calendar. Pope Gregory XIII died in 1585, so that his calendar has been in use in Catholic countries since the beginning of the 17th century. In England it was not adopted till 1752, at which time the beginning of the year was shifted from March 25th to January 1st. Thus our present calendar has been in use but 161 years. You will find this in Todd's "New Astronomy," which we send for $1.45 postpaid.

(12905) G. A. C. asks: Can you tell me if there are firms which by some method make nitric acid from the air? A. Large quantities of nitric acid and nitrates are now made from the air by the agency of electricity. The principal plants are in Norway, where water power is cheap. We have frequently described them and reported their progress in our columns. We refer you especially to Supplement 1640, 1641, 1642, 1643, 1644, 1667, 1668, 1691, 1692, 1746, 1748, 1784. These twelve numbers we will send you for ten cents each, and they will give you a wide view of what is being accomplished in this direction. Probably more than 100,000 tons of commercial fertilisers and reagents will be made this year by this process.

(12906) E. H. asks: Will you please tell me the deepest distance that a man has ever dived in a diving suit or other deep sea equipment? A. A man with a metal suit is said to have gone down 300 feet under the surface of the ocean. Men however do not work below 100 to 125 feet for any length of time.

(12907) C. A. B. asks: What influence has the moon, if any, on the weather? We think that an expression of opinion coming from so eminent a source as the Scientific American would be of great interest to a large number of your readers. A. The moon has no influence upon the weather, so far as the Weather Bureau has been able to detect, after a long time spent in studying the changes of the weather and the course of the moon. There is always a storm in progress somewhere around the world, and if a full moon occurs it is evident that it will be stormy where the storm or low barometer is at that time and fair where the high barometer is, while the change of the moon occurs at the same time to all parts of the country. Storms have no connection with the phases of the moon.

(12908) G. A. B. asks: Please to tell me through your paper how the temperature of the ocean varies with its depth in the torrid zone. At what depth does it reach the freezing point? A. The temperature of the ocean water does not reach the freezing point anywhere in the torrid zone. If it did, it would freeze and not be water, but ice. The lowest possible temperature below the surface of water everywhere is that of the maximum density. In fresh water this is at 39 deg. Fahr., and for salt water it is somewhat lower, but not much lower.

(12909) J. S. P. asks: Will you please explain the cause of the following mysterious experience? The writer with others, ladies and gentlemen, spoke in rotation into a recording phonograph. In the reproduction all the voices came out clearly except where the writer's should have been, but there the record was silent, not a sound. His voice perhaps was the heaviest of the company. The aim was to maintain the rate of revolution of the machine the same throughout. A. We have often noticed in testing voices that what seemed to the ear to be the stronger voice did not affect the recording stylus of the phonograph as much as a voice which seemed much lighter. We have attributed it to the fact that a heavy voice, that is, one of a low, deep tone, is frequently destitute of the upper partials which give fullness to the tone, and, we think, affect the recording apparatus more strongly than do the lower tones.

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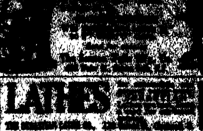

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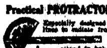

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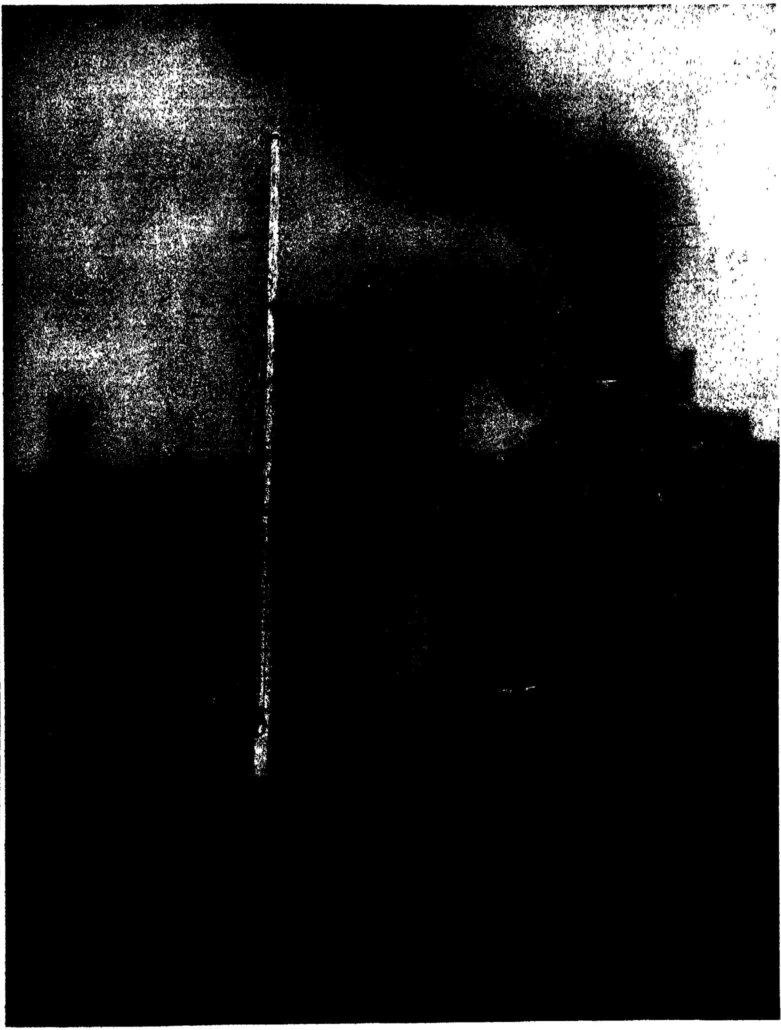

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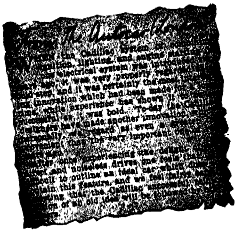

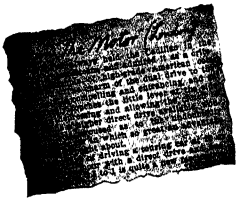

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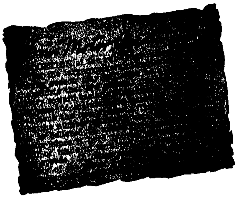

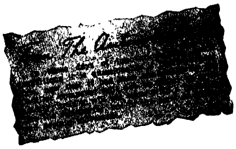

Cadillac Motor Car Co. Detroit, Mich.

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NEW YORK, JANUARY 17, 1914

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Dredging Out the Culebra Slide

In bygone ages that strip of land ten miles wide by forty long, which is now known as the Canal Zone, was under water. Its upper layers or strata were formed by a slow deposit of solid materials, which, in the course of ages, settled to the bottom and became more or less compacted. Ultimately, volcanic action raised this portion of the floor of the ocean above the level of the sea and formed the Isthmus of Panama. The bed of the ocean as thus elevated was lifted irregularly and in considerable confusion. Here and there, the molten igneous rock was forced up through the overlying marine deposit, destroying the general level and producing that confused topographical appearance with which every visitor to the Isthmus is familiar. When these volcanic agencies quieted down many centuries ago, the dry land, as thus formed, consisted of ridges of hard igneous rock, between which, broken up into great confusion, lay the above mentioned masses of submarine deposits, in various stages of hardness, but possessing very little resistance to crushing or sliding or other movements, should the conditions of equilibrium into which it had settled be once disturbed.

Then came the engineer with his drilling machines, dynamite, steam shovels and dredges, and proceeded to cut a deep and broad pathway through this geologically confused mass of material. Where he encountered the volcanic rock, that material stood up to the arbitrary slope which the engineer had determined upon for the sides of his great excavation; but when he cut into the looser marine deposited material, he began to get into trouble. Nature took the matter in hand, laughed at the engineer's contours and slope stakes, and proceeded to grade the sides of the cuttings according to her own liking. Generally speaking, she preferred a slope of one to seven, as against the engineer's slope of one to two. As a matter of fact, nature has been a very active agent in the excavation of the Panama Canal; for between thirty and forty million cubic yards must be credited to her activity as against one hundred and ninety million cubic yards done by the engineers of Uncle Sam, or, say, something over one sixth of the whole.

Very early in the work did nature begin to have her say in the matter of digging a canal at Panama. In fact, over thirty years ago, when the French commenced excavation at the deepest point of the canal, the Cucuracha slide caused the French engineers many an hour of anxious thought, and as the Cucuracha slide was the first, so to-day it is the last problem to be solved.

The accompanying illustration shows the dredges at work on this slide. The deepest excavation at Culebra occurred where one of those great masses of igneous rock forced their way through to the surface. Immedieeately to the south of it, and on the east side of the canal, is a large pocket of soft material which, with rare intervals of repose, has been steadily slipping down into the canal prism, as the work of excavation went down and the toe of the slope was cut away. So long as the steam shovels were at work, it was possible to shovel the material out about as fast as it came. When the tracks were taken up and the shovels removed, previous to blowing up the Gamboa dike, there was an interval in which the slide had, perforce, to be left to its own devices, and it moved into the cut until the prism was filled up approximately to the full depth of 45 feet.

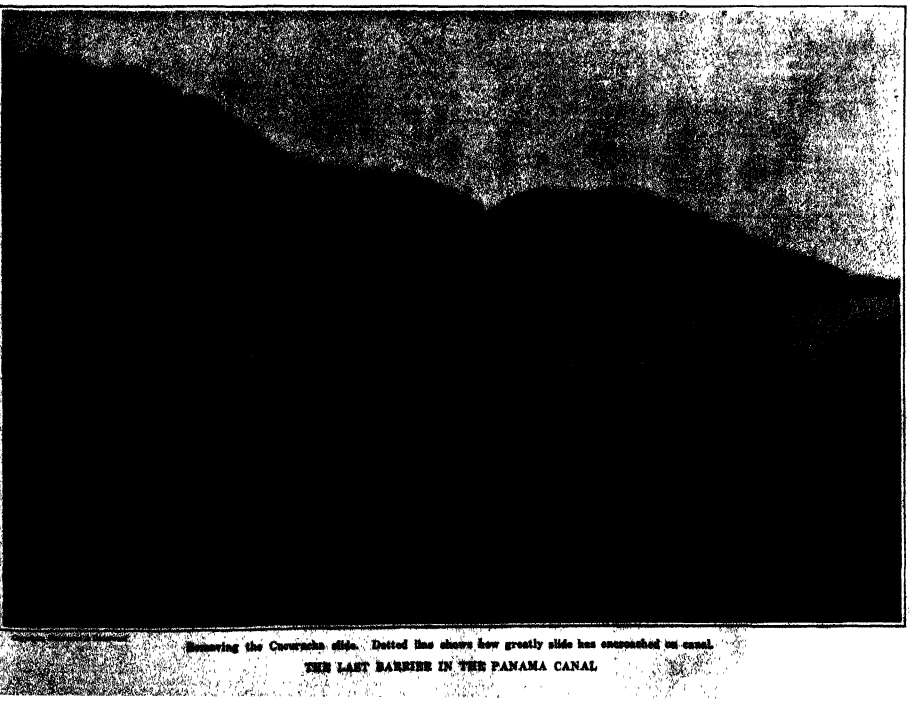
For several weeks past a whole fleet of dredges has been attacking the slide, and, according to the last dispatches, the channel through the base of it has been widened to a width of about 150 feet and a depth of 16 feet. The dotted line in our illustration shows approximately where the eastern bank of the canal should be. All the material on that side to the west of this will have to be taken out. The excavating plant, according to the latest dispatches, consists of three dipper dredges and two ladder dredges. Two 15-yard dredges, now nearing completion, will soon be at work, and they will make short work of the slide—probably.

A New Source of Paper Pulp

THE alarming dearth of raw material for paper making has stimulated research in this direction for several years. *La Revue* gives an account of the successful efforts now being made to produce excellent paper pulp from the *Hedychium coronarium*, a fibrous plant of the ginger family, having its origin in India, but growing in tropical parts of Asia, Africa, and America. The members of this family have fibrous stalks of various heights ranging up to 2 feet 6 inches or more, and covered with leaves

From the dry fiber a very good pulp is obtained, one hectare of land yielding 14 tons of fiber, which produces about 8 tons of pulp The cultivation demanded is inexpensive, and there are two or three harvests a year.

The process of treatment is simple—the plant is cut, pressed between rollers to dry it, beaten, and then heated with a varying proportion of soda. It may be *broken* instead of beaten, but in this case the paper is less fine in quality, though on the other hand it is much tougher.



Removing the Cucuracha slide. Dotted line shows how greatly slide has encroached on canal.

THE LAST BARRIER IN THE PANAMA CANAL

SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Ships that Break in Two

OCCASIONALLY, but fortunately very, very rarely, ships have been known to break in two while they were being driven across the seas. Several years ago this thing happened to the fastest torpedo-boat destroyer in the world, the "Viper," which was credited with having made thirty-six knots over the mile course. It happened last week to a large tank steamer before it had traveled very many miles from Sandy Hook.

The breaking of a ship's back is a common occurrence in cases where they have run upon the beach, or fetched up on a shoal of sand or rock—but that is to be expected. In these cases the breaking apart generally results from a falling tide leaving the vessel supported only amidship or only at the ends. As the tide falls away from the vessel, and her weight becomes less and less water-borne, the longitudinal bending stresses increase, till a point is reached where the plating tears apart, generally along a zigzag line of plate riveting or along a vertical straight line of bulkhead connection.

But it is not necessary that a ship be on the beach, or hung upon a shoal, to run the risk of having her back broken. This catastrophe, as the disasters to the destroyer "Viper" and the tank-ship "Oklahoma" show, may happen on the high seas and in deep water. It occurs very rarely, largely for the reason that several contributory conditions must be present simultaneously before it will happen. In saying this, it will be understood, of course, that poor design may wreck any ship that sails the seas. If the naval architect fails to build his ship with sufficient depth in proportion to her length, or if she be shallow and he fails to put sufficient extra metal into her bottom and upper decks to give the proper girder strength, she is liable to break in two in her first encounter with heavy weather.

But we are not considering poorly-planned vessels. The destroyer "Viper" was designed by a prominent architect, and built in one of the leading yards of Great Britain; and the tank steamer "Oklahoma" was constructed in what is considered to be the finest shipbuilding yard in this country, and presumably she was well designed.

Just here, it may be well to state that the bending stresses tending to wreck a ship so far as wave action is concerned, come either when the ends of the ship are deeply immersed in two following waves, or when the body of the ship is deeply immersed, and the two ends are in the troughs of the sea. Under the first condition, the ship may be considered as, roughly speaking, a bridge supported on two end piers. Under the second condition, it may be considered as a drawbridge swung open and supported at its center. In the first case, the ship will tend to sag amidships, in the second, to sag at the ends

Now these conditions will be aggravated when the distance from crest to crest of wave is approximately the same as the overall length of the ship, particularly if the seas are short or steep The stresses tending to bend or break the ship can also be very seriously affected by the loading Thus, a ship that is running light as to cargo, and is water-ballasted forward to offset the weight of engine and boiler and full coal bunkers at the after end of the ship, would be subjected to specially severe stress when she was supported at her mid-length during the passage of the crest of the sea.

How severe these bending stresses are may be judged from the fact that one of the earlier 23-knot ocean liners was proved by exact instrumental measurement, taken for the purpose while she was being driven hard into very heavy head seas, to have a vertical movement at the ends with regard to the midship section of twelve inches. Though this was excessive, it does not prove that the ship was structurally weak; for in such vessels the deep double bottom and the continuous steel upper decks, provide sufficient top and bottom chord material to permit the necessary extension and compression of the steel without exceeding the elastic limit.

In the tank steamer, however, the provision of sufficient girder strength is not so easy of accomplishment as it is in the case of an ocean liner with its plurality of upper steel decks. The tank steamer, and in fact all steamers of the Great Lakes type that are built to carry heavy freight in bulk, consist, throughout the greater part of their length, of a double bottom, the two sides and a single upper deck; this last being pierced by many hatches, some of them of very large size. Much ingenuity has been shown in the endeavor to make these long shallow ships sufficiently strong to carry their heavy load safely through heavy seas.

Great technical interest will attach to the investigation of the accident to the "Oklahoma." Say what we will, this accident must necessarily arouse a certain degree of distrust of present tank-steamer construction; and it is sincerely to be hoped that sufficient evidence will be gathered from the survivors to enable the naval architect to determine just where the rupture commenced, and exactly in what manner the ship's plating tore asunder. It is important to know whether the fracture followed a zigzag line along the side plating or whether, as Mr. Holmes has suggested, it followed a vertical line of rivet holes where a transverse bulkhead was attached to the hull.

The Kahn Act and Foreign Exhibitors of Patented Articles at the Panama-Pacific Exposition

NO remarkable prophetic gift was needed to foretell the storm of protest that has followed the approval of the Kahn bill—a measure which is intended to protect foreign exhibitors at the Panama-Pacific Exposition from patent and copyright infringement by Americans, by enabling a foreigner who has patented his product in his home country to obtain absolute protection in this country by the mere filing of the necessary papers, without any search as to novelty and without complying with any of the rigorous requirements of the American patent law. The bill was so clearly unconstitutional that few thought it possible that it would ever pass. And yet the impossible has happened.

The defects of the measure are so apparent that as it stands it cannot endure the legal scrutiny of the United States Supreme Court. It may be doubted whether Mr. Bulkley's painstaking revision will help matters much, although it seeks to remedy the more crying evil of the original by providing that the exhibits shall not enjoy the protection so generously accorded by the Kahn act if they have been "in public use or on sale in this country" or shall have "become the property of another under the laws of this country." While this may remove the absurdity of preventing an American manufacturer from producing an article unpatentable in this country, but patentable in some European countries, it throws upon the foreign exhibitor the burden of proving that his product is indeed patentable in this country and that an American defendant is an out and out infringer. In other words, the foreign exhibitor might just as well apply for a United States patent in the regular way if he is to enjoy any benefits from the Kahn act as Mr. Bulkley seeks to amend it.

It is difficult to understand why the exposition authorities should have been so deeply concerned in the protection of foreign exhibitors. We are not aware that any foreign country has ever extended to exhibitors of other nations at any exposition the rights and privileges extended by the Kahn Act. Furthermore, a foreign manufacturer who exhibits at San Francisco no doubt does so for commercial reasons. If he hopes to interest Americans in his product by availing himself of the opportunities accorded him at San Francisco, there seems to be no valid reason why he should not protect himself in the manner prescribed by the constitution and the patent laws of this country.

As they now stand, our patent laws are probably the most generous of their kind in the world. From the very first the United States of America set an example to the world in freely according to foreigners the same measure of protection for patentable inventions as to Americans. If there were any possible discrimination against foreigners, there might be some excuse for the Kahn Act; but as matters now stand, the Act places the foreign manufacturer of an invention which he has patented in his own country, but which for good reasons is unpatentable in this country, in a far better position than his American rival.

Nothing short of the absolute repeal of the Kahn Act can be justly condemned. Not only is it unfair to Americans, but it deals unfairly even by the foreigners whom it is supposed to protect. Of the unconstitutionality of the Act as it now stands there can be no question. Yet the exposition authorities are apparently lulling foreigners into the belief that they may safely exhibit inventions in San Francisco, which in the eyes of the Patent Office and of our courts would be public property. What will be their astonishment when they seek to apply the Kahn Act to their special cases and find themselves thrown out of court? Will we not be accused of double dealing? The governments of Europe have not all unanimously decided to participate in making the Panama-Pacific Exposition a success. A general feeling is rife that there have been too many expositions. If the Kahn Act ever comes up for judicial construction and is declared unconstitutional and void, it may be doubted if foreign governments will look with favor upon future American expositions.

The Sun-power Plant in Egypt

A RECENTLY prepared report on the sun-power plant at Meadi, Cairo, gives some important data on this highly interesting development.

A series of trials was carried out under favorable weather conditions, in which, we are told, the area of sunshine collected and utilized in heating the five boilers was 13,269 square feet, and the maximum steam pressure generated was 1.1 pound per square inch above atmosphere, the minimum pressure 1.0 pound per square inch.

The average amount of steam generated per hour throughout the trials was 1,160 pounds. The maximum amount of steam generated during any one hour was obtained between 1:10 and 2:10 P. M. on August 22nd and amounted to 1,442 pounds, while the minimum generated in any one hour was obtained between 3:15 and 4:15 P. M. on August 25th, and amounted to 886 pounds.

In order to obtain the best results from steam at the low pressure of the sun-power system, it should be utilized in a suitable steam engine. A condensing engine especially designed for use in connection with the sun-power boilers was tested in 1912, and when it was developing 97½ brake horse-power the steam required at a pressure of 1 pound per square inch above atmosphere was only 22 pounds per brake horse power.

Had the installation at Meadi consisted of nine sun boilers instead of five they would have produced enough steam to have kept this engine running and developing an average of over 95 brake horse-power throughout the twelve and a quarter hours occupied by the trials.

What progress has been made during the last two years can be seen by comparing the results here quoted with those obtained at the Tacony (Philadelphia) plant in 1911:

The total area of sunshine collected by that plant was 10,296 square feet. The average amount of steam produced throughout a 4-hour trial on August 10th was 693 pounds per hour. The mean steam pressure during the four hours was 1.2 pound per square inch *below* atmospheric pressure.

The most important figure, however, and one which is closely comparable, is the steam produced per hour per square foot of sunshine collected. The maximum for the Tacony boiler was 0.090 pound per square foot per hour, whereas the corresponding figure for the Meadi boiler was 0.12 pound per square foot per hour, which is equivalent to an increase of 33 1/3 per cent, a very gratifying improvement, especially when it is borne in mind that the mean steam pressure at Tacony was 2 pounds per square inch less than at Meadi.

That this improvement is not entirely due to the generally better climatic conditions of Meadi as compared with those of Tacony seems to be indicated by the fact that the Tacony result was obtained when the mean temperature in the shade was 90.4 deg. Fahr. and the mean humidity 45.5 per cent, while the Meadi result was obtained when the shade temperature was 95.5 deg. Fahr. and the humidity 35 per cent. Hence a considerable portion of the 33 1/3 per cent increase of output may fairly be attributed to improvements in the design of the plant.

These results seem very encouraging, and we may express the hope that this pioneer undertaking may meet with the success that it deserves.

A Radio Manual will shortly be issued by the United States Signal Corps, dealing with the installation and operation of radiotelegraphic apparatus, especially field stations, and intended primarily for the guidance of the regular and militia forces. After much experimenting the Signal Corps has devised field radio outfits that will probably not be materially modified for some years to come. A radio pack set, which is carried by 3 mules, can be put in operation in two minutes, weighs 370 pounds, and under service conditions has a range of 25 miles. A wagon set of 2 kilowatts power has a range of more than 200 miles. It is made up of a pintle-type wagon, drawn by four animals, the rear cart containing the power plant and the front the operating apparatus.

Electricity

Wireless on the Great Lakes.—According to the Department of Commerce, the disastrous storm of last November on the Great Lakes furnished a signal illustration of the necessity of equipping lake vessels with wireless telegraphy. All vessels so equipped received warning of the storm and sought shelter, while 19 American vessels without wireless were lost. About 50 vessels are now preparing to add wireless telegraph apparatus to their equipment.

Large Plant for Producing Carbide and Nitrate of Calcium.—An electro-chemical works which ranks among the large Swedish plants of its type, has been installed near Johannesburg, and it is designed to turn out carbide and nitrate of calcium upon a new process invented by Engineer F. Carlson. It is stated that there are now running on this principle, four 400-kilowatt furnaces using single-phase current, for the production of carbide. As to nitrate of calcium, which is employed for fertilising purposes, there are in use six furnaces on the 3-phase system of 2,600 kilowatt size. In order to secure what current the present plant demands, a large hydraulic plant is erected at a cost of over a million, and it operates by power from the Ljungan stream.

Largest Electric Hoist in America.—One of the largest electric hoists in the world, and exceeded only by a few in South Africa, will be installed in the Granite Mountain shaft of the North Butte Mining Company. The hoist will have a capacity of 300 tons per hour hoisted from a 2,000-foot level, or 200 tons per hour from a 4,000-foot level. The shaft is now approaching the 2,900-foot level. The hoisting drum, 12 feet in diameter, will be driven by a direct-connected electric motor supplied with power from a motor generator set provided with a 50-ton flywheel. The flywheel will give up some of its stored energy to supply the peak load drawn by the hoisting motor. The induction motor of the generator set will have a continuous rating of 1,400 horse-power and the hoisting motor will have a maximum intermittent rating of 4,500 horse-power.

Turbine Progress in Europe.—We note that the Brown-Boveri works is engaged in constructing a turbine group of no less than 40,000 horse-power size, it being intended for the Mark electric station in Westphalia. The alternator of this group is designed for 10,000 volts three-phase and 50 cycles and operated at 1,000 revolutions per minute. The turbine works on superheated steam at 350 deg. Cent. and 13.5 atmospheres pressure at the inlet, the entire group measuring about 33 feet long. Among other large turbines of this type we may mention the 30,000 horse-power alternator lately set up in the Reisholz plant near Düsseldorf, and a similar group is now building at the same works for an electric plant near Cologne. It is expected that steam turbines of as high as 50,000 or 60,000 horse-power will be constructed as the next move.

Electrolytic Extraction of Copper in Chile.—German electrical apparatus is now installed in a plant located in Chile for extraction of copper from the ore, and the works are said to be operating quite successfully at present. It makes use of the new Siemens-Schuckert electrolytic process. The electric station is situated at Cobija on the coast and 180 miles from the copper mines, which are inland, and the current is sent to the copper extraction plant at the mines by a power line. The electric station is steam operated, and is equipped with 16 boilers which are fired by oil fuel. Four steam turbines are each coupled to an alternator of 15,000 horse-power size which delivers 5,000 volts, and step-up transformers raise the voltage to 110,000 volts for operating the power line. At the copper mines is a substation containing motor-generator sets of 3,000 horse-power size which receive the current from the line and convert it to 250 — 190 volt current for use in the electrolytic tanks.

Electrifying Railways in Norway.—In Norway the government proposes to carry out quite an extensive scheme for applying electric traction to the railroads. According to an official report as to hydraulic resources, the state already owns enough water power to serve for nearly all the railroads in the south and west of the country. However, as it is intended to go into the matter on as large a scale as possible, the government is seeking to purchase as many falls as possible in order to obtain the needed amount of power. A great outlay of capital will be needed to carry out the extensive railroad project. Among the principal railroads are seven lines, including two from Christiania to the Swedish frontier, and others from that city to Gjoevik and Drammen. For the high-tension power lines from the turbine stations to railroads, including also the substations, the outlay is $12,000,000. Notwithstanding the considerable cost of adopting electricity for the railroads, it is expected to secure much economy in operating these lines. Parliament lately decided to begin the first work on the Christiania-Drammen railroad line. Norway is so rich in hydraulic resources that there is little excuse for the employment of any other power.

Science

An Institute for Bibliographic Research, the first of its kind in America, will soon be established in Chicago, if the plans of the Bibliographical Society of America are carried out.

A New Product of Seaweed, the invention of which is announced from Liverpool, is called "algin," and is used in the manufacture of non-inflammable cinematograph films and in the treatment of paper to make the latter water, flame and germ proof. Algin is said to be odorless.

An Institute of Oceanography, with a fine aquarium, is to be established at Ste. Adresse, a suburb of Havre, in a large park overlooking the bay of the Seine. It is hoped to have the institute open in time for the scientific congress to be held at Havre in the autumn of 1914. A feature of the institute's work will be practical instruction to fishermen.

Urotropine as a Preservative of Caviar.—A consular report states that of about 1,400,000 pounds of caviar obtained each year by the Astrakhan fisheries, approximately 75 per cent is exported, and the only preservative thus far found to keep the caviar fresh is urotropine, which is added in the proportion of 1 to 1,300, and is claimed not to be injurious to health.

The Discovery of Minor Planets still goes on apace. During the year ended June 30th, 1913, 67 of these bodies were given provisional numbers, though 5 of these subsequently proved to be old members of the asteroid family. Of the remainder, 19 were discovered at Heidelberg, 7 at Johannesburg, 9 at Neuchâtel, 11 at Simeis, 3 at Vienna, and 13 at Winchester. All minor planets from No. 1 to No. 727 have now been named.

A Plague of Wild Horses.—The Canadian government has been urged to take measures for checking the depredations of wild horses in the Peace River country in western Alberta and eastern British Columbia. The horses have been making raids on the ranches, killing many domestic horses and leading away valuable mares which had been imported at considerable expense by the settlers. The culprits are said to be the descendants of horses abandoned during the gold rush to the Yukon territory in 1897-98.

Soda Deposits of Lake Magadi.—The American consul at Zanzibar reports that Lake Magadi (spelled "Maggadi" on British official maps), lying southwest of Nairobi, in the southern part of British East Africa, is an almost inexhaustible source of soda. As the deposits are removed they are replaced through soda springs from which crystals of soda are constantly forming. A 95-mile railway has recently been built to connect this lake with the Uganda Railway, and a factory for preparing the soda is to be built at the lake. It is estimated that 160,000 tons of the worked product will pass over the railway to the sea. The soda deposits cover 30 square miles.

Lake Erie Outlet.—The International Waterways Commission has published its final report on the proposal to establish a submerged dam or weir at the outlet of Lake Erie for the purpose of raising the water in all the Great Lakes except Ontario. Its cost would be about $3,000,000, and the Commission unanimously recommends that a treaty be entered into between Great Britain and the United States providing for its construction. The report states that the level of the lakes has been appreciably lowered by the Chicago Drainage Canal and the Erie Canal. To illustrate the importance of this question, it is pointed out that the freight boats on the lakes are built to the greatest capacity the depth of harbors and channels will permit, and that every added inch of water means an increased capacity of 85 tons in these big vessels.

The Tsangpo-Brahmaputra Question Again.—The tantalizing question as to the nature of the connection between the Tsangpo River, of Tibet, and the Brahmaputra, of Assam, is not yet fully settled, despite the large number of explorers who have tried to clear up this celebrated mystery. It will be recalled that when a punitive expedition was sent by the British authorities against the savage Abors a couple of years ago, it was fully expected that the party would complete the exploration of the Dihong River, which undoubtedly forms the connecting link between the two great and well-known rivers (or, properly, parts of a common river), and that white men would then for the first time behold the immense falls supposed to exist where the river breaks through the mountains. Although the expeditionary force took along a scientific staff for the purpose of exploration, the geographical results of the mission were disappointing. During last summer British officers again explored in this region. One party reached a point on the river four days' journey below the supposed falls, while another penetrated to a point on the Tsangpo six days above the falls, but the falls themselves had not yet been reached when the last news was received in India. The barometric observations of the two parties seem to confirm the great difference of elevation implied by the existence of the falls and cataracts of Tibetan tradition.

Aeronautics

Beachey's Latest "Looping the Loop" Performance.—On December 25th Lincoln Beachey "looped the loop" five consecutive times from a height of 750 feet. Beachey turned a double loop at a height of only 300 feet.

A Monument to Capt. Scheimpflug.—On December 6th, 1913, a tablet was unveiled in Vienna to commemorate the achievements of the late Capt. Scheimpflug, who, as our readers will probably recall, was one of the first to interest himself in photography from aircraft. His photogrammetric camera-gun has been described in the SCIENTIFIC AMERICAN.

A New Army Altitude Record.—A new army altitude record was made at San Diego, on December 18th, by Lieut. H. B. Post, who ascended to a height of 10,600 feet, a gain of more than 2,000 feet over the previous record. The ascent was made in army carrying aeroplane No. 23 from North Island. Lieut. Post made the first 3,000 feet at an average rate of 540 feet a minute.

A French Mail Line by Air Across the Sahara.—The National Aerial League has completed plans for a flight of a flotilla of aeroplanes across the Sahara or Great Desert. They will start from Oran, Algeria, and the final landing will be made at Timbuktu, French Sudan, a distance of 1,400 miles. Pyramids of stones will be placed at intervals to mark the route. If the experiment proves successful the establishment of a regular air mail service will be considered.

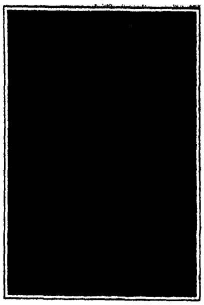
Naval Aeronautics.—A definite programme for the development of aviation in the navy has been decided upon and will be put into operation at once. A naval aviation school will be established at Pensacola, the battleship "Mississippi" will be assigned to that station for use by the navy aviators, and during the winter practical experiments and training of naval officers in the operation of aeroplanes will be carried on. Flights will be made from the deck of the "Mississippi" and other experiments conducted in developing the use of the aeroplane in connection with battleships.

Vedrines' Flight from Paris to Cairo.—The flight of Vedrines from Paris to Constantinople in five stages and his supplementary journey to Cairo in three more stages must stand as one of the most remarkable achievements of that remarkable aviator. He defied the German authorities, who had refused him permission to fly over German territory (incidentally highly irritating German nerves by circling over a fortress) and braved the high winds of the Taurus Mountains, which proved the undoing of Daucourt. How far Vedrines will push on in his expressed intention of attempting the encircling of the globe remains to be seen. Invitations to fly to this or that point reach him almost daily.

A New Giant Biplane.—The Russian aviator and designer, Sikorski, whose huge aeroplane was described and illustrated in these columns last year, has now built a still larger machine, weighing no less than three tons and a half. It is said that the new machine is propelled by four motors of 100 horse-power each; but this is also the engine power of the old machine. The new biplane is said to have a carrying capacity of twenty people, and that cabins with sleeping accommodations are provided. On the trial trip the machine is said to have risen in the air after a run of 100 yards and to have circled the grounds without difficulty. The SCIENTIFIC AMERICAN hopes to publish a detailed account of the machine.

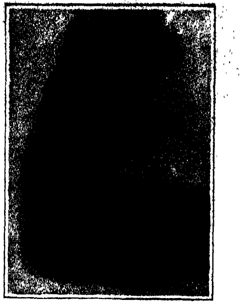
The Signal Corps Aviation School.—Teaching army officers the subjects of aero-mechanics and aeroplane design has something picturesque about it if we may judge from the account which one of the instructors gives us. When the clock strikes, the pupils flock from all corners of the sky and volplane down to the instructor's pulpit and blackboard in a great white tent. They sit erect and still as mice, smoking as they listen, while the dogs sleep at their feet. A beginning has been made in what may develop into regular and systematic annual courses of lectures accompanied by problems and experiments. The instructors thus far chosen are Dr. Alfred F. Zahn, Prof. Durand and Dr. Humphreys.

Marking Military Aircraft.—According to Major Bannerman-Phillips in the *United Service Magazine*, "it was announced some time ago that fresh orders would be issued shortly by the French Ministry of War regarding imposition of distinguishing marks on military aircraft." In future all military aeroplanes will bear on the under surface of each wing (the lower wing in the case of a biplane) a tricolor cockade one meter in diameter. Dirigible balloons, on the other hand, will bear on the under surface of the front of the balloon its name in large black letters. At the rear end of the balloon will be the national flag with a tricolor pennant immediately above and on the same halyards. The dimensions of the pennant are: height, half that of the flag; length, one and one half times the length of the flag. Free balloons owned by the military service are to have from one of the suspension cables the national flag, and on the opposite cable a tricolor pennant."

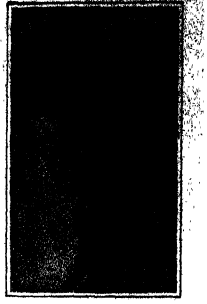


Gray lizard.
(*Lacerta muralis*) adult, full size.

Young lizard's fore foot.
(Magnified 20 diameters.)



Elbow of adult lizard.
The muscles represented.



Young lizard's fore leg.
"(Magnified 20 diameters.)

X-Ray Photographs of Microscopic Objects

How They Are Made by the Goby Method

By the Paris Correspondent of the Scientific American

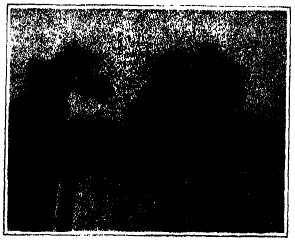
THE new apparatus made by the French scientist Pierre Goby opens up an attractive field of research which he calls micro-radiography, from the fact that it is now possible to obtain X-ray photographs of the internal structure of microscopic objects As it appears that this is the first practical application of the X-rays in microscopic work, the new method is attracting much attention among scientists, as it is recognized that it will contribute greatly to our knowledge of minute animal life. Biological and kindred sciences have recourse to the microscope at every moment, but it often happens that specimens are opaque, hence the necessity of making sections of the objects in order to observe their internal structure, but this is well known to be a great disadvantage from the fact that nothing is now left of the exterior of the objects under examination, and besides, the systematic study of sections of an object requires numerous and patient observations in order to reconstitute the *ensemble* from the various details While the use of the X-rays has been valuable for observing the internal structure of large objects such as can be seen and photographed directly, the fact that such rays do not obey the laws of refraction and cannot be used with lenses makes it impossible to apply them directly for making micro radiographs.

The problem is solved by M Goby in an ingenious way by his new method which consists in applying the minute object directly upon a photographic plate and sending upon it a beam of rays which are as nearly as possible perpendicular to the plate, thus avoiding all penumbra and giving a record of all the finest details of the object in its internal parts with such precision that after developing, the minute images thus obtained can be enlarged from 15 to 45 diameters in an ordinary micro-photographic apparatus On the other hand, the quality of the enlarged image naturally depends upon the fineness of grain of the photographic plate after developing, and he therefore uses a plate which has as fine grain as possible and at the same time is sensitive enough to allow of a reasonably short exposure.

The construction of the apparatus is shown in the photographs, the general idea being to place the minute object directly upon the film side of a small photographic plate upon the base of the instrument and within a dark chamber of cylindrical shape. The X-ray bulb placed at the top of the device sends down the rays through a central tube which serves to direct the rays nearly vertical upon the object and the photographic plate in order to make a "shadow" upon the latter, and the main point in the present makeup is to produce rays which fall as nearly perpendicular as possible to the object and plate, for were this not done and the rays were diffused in various directions, it is evident that the record made on the photographic plate would be blurred by such irregular rays and the minute and delicate outlines of the internal structure would be confused and lost. It would then be impossible to enlarge such a plate so as to obtain a view such as would show all the details to the naked eye.

The dark chamber is made up of a pair of large sliding metal cylinders, the upper one carrying a sliding tube through which the rays pass. The whole device is held at one side by a telescoping support with ball and socket joint so that the apparatus can be raised out of the groove on the bottom plate and turned up so that the observer can look through the lower end of the tube to see that the rays come through properly. On the top is a support for holding the X-ray bulb, provided with rack-and-pinion adjustments so as to set its position at the proper distance from the tube. Turning up the device, the observer sees that the rays fall through the tube as is required, and after adjusting for this purpose, he brings down the dark chamber upon the base, all light being thus cut off from the inside. Previous to this he has placed the specimen upon a small square photographic plate, preferably of a fine grain, and directly in contact with the sensitive surface without putting black paper between the two, so that the resulting image or shadow is very sharp and clear. The rays are directed along the axis of the tube by using a small diaphragm at the top, using as a finder a narrow tube near the bottom, so that a vertical beam of the rays comes out of the tube upon the object below in order to make the photographic impression on the plate.

The X-ray bulb can be adjusted in position so that its rays fall directly on the plate.



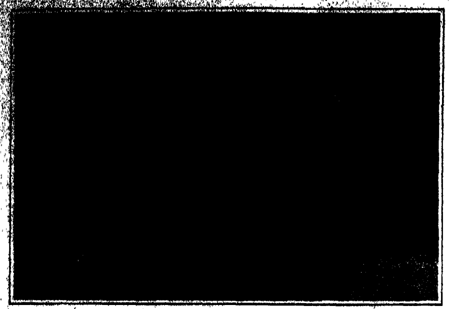
The general idea is to place the minute object directly on the film side of a photographic plate.

The upper diaphragm disk of the apparatus is constructed entirely of very thick lead so as to cut off the passage of the rays except through the small central hole, and below it is a disk, serving as a shutter to stop off all ordinary light rays which might leak in from the top, but allowing the X-rays to pass through. At the lower end of the tube is a finder device which consists essentially of the very narrow metal tube held between the two permeable disks. Below this is a small fluorescent screen fitted into the tube end and covered with a plate of lead glass in order to protect the operator's eye. To make sure that the ray falls just in the center, the X-ray bulb is moved about until the small luminous spot appears surrounded by a small black circle which is the shadow of the small tube and indicates that the rays are quite vertical. Then the finder as a whole is drawn out of the main tube and the apparatus put in the vertical position so as to cover the object as above stated. This latter operation is carried out in the dark room when the photographic plate is put in, the X-ray bulb being now out of action. Then the bulb is set working on the electric current for the required time, varying with the transparency of the object and lasting from one to three minutes. The quality of the rays produced by the bulb can also be varied to suit the case by the use of well known methods. It is also possible to widen or narrow the field of the rays upon the photographic plate by approaching the tube to the X-ray bulb or by lowering it, the tube being made sliding to this effect.

The New Buildings of the Paris University

OWING to the lack of room in the Paris University buildings for the departments of chemistry and researches upon radium, it was decided to erect commodious quarters for such work. The new buildings in the Latin quarter are now almost finished and contain well fitted laboratories and halls. The largest building is the Chemical Institute, which covers an extensive space and is said to be the most considerable in Europe. But it is the new "Radium Palace" which deserves special mention, or more properly, the three buildings which go to make up the Radiology Institute. The first, or "Curie building," is designed for laboratories and courses upon radio-activity, and will be under the special direction of Mme. Curie. Opposite it is a similar edifice built with a subsidy of $80,000 from the Pasteur Institute, to be used for the physiological applications of radium. Between the two is the smallest, but the most interesting building, the "Temple of Radium," which is a veritable strong-box, as it might be called, for holding considerable amounts of radium salts and possibly pure radium. The walls are lined with thick lead sheet, which is needed in order to prevent the emanation of "rays" from passing. We expect to give a further description of these structures when they are fitted up. The present extensive grounds, coming from the demolition of an old convent, will now be an important university center, the first building to be erected here having been the Oceanographic Institute. Another part of the ground will be occupied by the Geography Institution, to be built with a donation of $1,000,000 made by Marquise of Arconati-Visconti, and Architect Nénot is also engaged on the plans for the Institute of Ancient and Modern Art and the Arts Library.

Hogs' Brains are being bought on an extensive scale by a company in Denmark from the abattoirs of that country for use in making lecithin and cerebrin, which are exported to Germany and Switzerland for use in medicine.



A wind shield for cyclists with the aid of which Berthet has beaten some indoor records.

Interior of Bunau-Varilla's wind shield. Through the celluloid window in front the cyclist sees the track.

A Wind Shield for Bicyclists

ETIENNE BUNAU-VARILLA, a son of Phillippe Bunau-Varilla of Panama fame, has devised the wind shield for bicyclists which is illustrated on this page. Cumbrous as the shield may appear, we are assured that a French cyclist, Berthet, easily beat various indoor records from one to five kilometers at the Velodrome d'Hiver in Paris.

The following figures are unusually significant because Berthet was not in particularly good physical condition:

The world's record of 1 minute 9 3/5 seconds for a kilometer with a flying start, made by Perchicot, but not recognized, was reduced to 1 minute 7 seconds. This is also better than Dupré's record of 1 minute 10 3/5 seconds, made in 1911 at Buffalo.

Jaap Eden's record of 1 minute 16 3/5 seconds for a kilometer with a standing start, made in 1896 at Bordeaux and never beaten, was equaled.

The world's record for 5 kilometers with a standing start, made by Verlinden at Anvers in 1910 (6 minutes 56 4/5 seconds) was beaten by exactly 1 minute 10 seconds.

The 250-meter track of the Velodrome d'Hiver was covered in 15 2/5 seconds, or at an average speed of 58.450 kilometers an hour.

Berthet recently raced with Egg under ordinary conditions. He succeeded in beating the time he made in that race with the aid of Bunau-Varilla's wind shield, as the following table shows:

	Against Egg.	With the shield.
1 kilometer	1m. 22s. 3	1m. 16s. 3
2 kilometers	2m. 40s. 4	2m. 23s. 4
3 kilometers	4m.	3m. 31s. 4
4 kilometers	5m. 19s. 1	4m. 39s. 3
5 kilometers	6m. 37s. 3	5m. 46s. 4
Average speed per hour	45.3 kil.	51.902 kil.

The last four kilometers in the foregoing test were covered at an average speed of 53.8 kilometers an hour.

These times were clocked by M. Durand, director of the Velodrome d'Hiver. Although not official, they are, however, instructive.

When it is said that Bunau-Varilla has taken a lively interest in aviation, the origin of his windshield is immediately apparent. Those who have followed the development of streamline bodies in airships, automobiles and aeroplanes, will discern at once that Bunau-Varilla has applied to the bicycle a principle which has been successfully incorporated in their vehicles by the more intelligent designers of airships and automobiles.

The wind shield is fish-shaped and consists of a light frame covered with fabric. When the cyclist is bent over in racing position, he is completely housed within the shield. A celluloid window in front enables him to keep an eye on the track.

It is quite evident that the shield is better than the many projecting surfaces which must be urged through the atmosphere when a bicycle is forced along, each surface stirring up the air and leaving eddies behind. With a properly shaped wind shield the air closes in behind the bicycle and the resistance is so markedly reduced that it is easy to understand why indoor records should be broken.

The Soot-and-Dust-fall of English Towns and Cities; 200 to 2,000 Tons per Square Mile per Annum

How it is to be Measured

By John B. C. Kershaw

THE first of October of the past year marked the commencement in England and Germany of a carefully planned and systematic attempt to measure the amount and to investigate the character of the solid impurities present in the atmosphere of many large towns and centers of manufacturing industry.

Fig. 1.—Diagram showing soot-and-dust-fall of Scotch towns in winter of 1910-1911, based on observations made by Chief Inspector Fyfe of Glasgow.

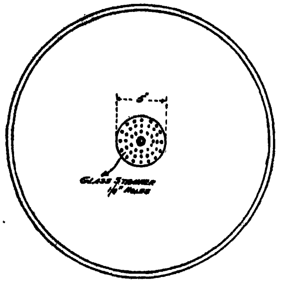


Fig. 2.—Plan of standard soot-and-dust gage, showing catchment area.

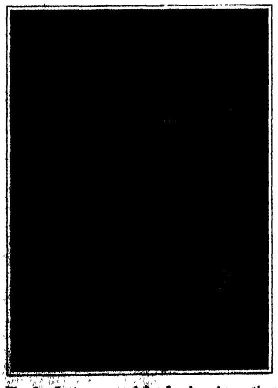


Fig. 3.—Soot-gage used for London observations of 1910-1911, exposed on house roof at Buckingham Gate. S. W.

Everyone is aware that the air of towns contains a much larger amount of soot and dirt than the air of country districts, for even in New York city, the state of the linen and curtains bears effective testimony to the dirtiness of urban atmospheres. But no attempts have been made until recently to measure accurately the relative amounts of impurity suspended in the atmosphere of the more thickly populated districts of town and country. The figures obtained in the tentative experiments carried out in London, Leeds and Glasgow, by different observers, in the years 1910-1912, are of slight value for comparative purposes, since they have been made by different methods, and under different conditions of observation The figures so far, however, have revealed the fact that enormous amounts of solid matter are suspended under ordinary conditions in the atmosphere, and are ultimately washed down with the rainfall upon the buildings and streets. Thus, the soot-and-dust-fall observations already made in London, have given totals varying from 105 tons per square mile per annum at Sutton in Surrey to 650 tons per square mile in the East End, London The experiments at Leeds gave totals ranging from 242 tons in the center of the city to 539 tons at Leeds-Forge, while Glasgow and Coatbridge have exceeded these figures with totals of 1,330 tons and 1,939 tons, respectively. These are staggering totals, when one remembers that this amount of impurity is suspended as a rule in the form of fine dust and soot particles in the atmosphere, and that only after heavy and long continued rain can the air we breathe be considered clean and free from solid impurities. As already stated, the observations made in London, Glasgow and Leeds were carried out under varying conditions by different apparatus and methods, and at the International Conference on Smoke Abatement, held in London in March, 1912, a strong committee was appointed to draw up the details of a standard apparatus and method for measuring the amount of soot and other impurities of the atmosphere. This committee, of which Dr. W N. Shaw, F.R.S., of the Meteorological Office is the chairman, has held five meetings in London, and has drawn up the details of the apparatus and method which have been chosen as most suitable for the observations required A circular letter was issued early in the past year to the public health authorities of all the more important English towns and cities, inviting their co-operation in the work, and it is satisfactory to note that the observations commenced in the following important centers on the first of October, 1913: Birmingham, Bradford, Crewe, Exeter, Hull, Leeds, Leicester, London, Malvern, Newcastle, Plymouth, York and Glasgow The voluntary Association of Steam Users known as the "Hamburg Verein für Rauchbekämpfung" has also agreed to commence observations with the standard apparatus and method in Hamburg. Valuable returns covering a very wide area will therefore soon be available relating to the amount and character of the suspended matter in city and town atmospheres, and with these data before them many of the municipal authorities will have no excuse for ignoring longer the very grave pollution of the air of their own cities.

It may be urged by some critics that, although the figures obtained by the adoption and use of a standard apparatus and method for recording the soot-and-dust fall will be interesting, they will serve no useful purpose, and that the money spent upon the observations could be used more satisfactorily and with greater advantage in other ways. To these critics it may be pointed out that the solid impurities suspended in the atmosphere of all towns and cities are harmful in three ways to those who either by choice or the necessity of earning their daily bread, live and breathe in this vitiated medium

First, by diminishing the amount of sunlight which falls upon the earth, these solid impurities suspended in the atmosphere directly lower the vitality of the human organism, and decrease its ability to resist disease. Cohen has shown that, in Leeds, from 25 per cent to 40 per cent of the sunlight is cut off by the smoky atmosphere In the second place, the soot and dust suspended in the air of all manufacturing towns, enter the lungs and choke up the pores and cells of the lung-tissue, thus hindering that rapid assimilation of oxygen by the blood and discharge of CO_2 and other waste-products, which are essential for the maintenance of health Finally, direct sunlight and pure air are now recognized as the best of germicides. Smoke and dust, by diminishing the sunlight and defiling the air, therefore promote bacterial life, and are thus helpful in the propagation of all infectious diseases.

In view of these scientific facts, it is evident that any series of observations which will place definite figures for the degree of pollution of town air in the hands of city authorities, and thus enable them to compare the purity of their own atmosphere with that of other towns of similar size and population, will give a real incentive to improvement—a stimulus which could be obtained in no other way. When for example, Glasgow can show by its records a cleaner atmosphere than Liverpool, or Pittsburgh than New York, or Manchester than Leeds, the upward progress will have commenced in earnest, and each city and town will strive to excel its rival in this competition for a purer air. These standard records of atmospheric pollution will also be useful for determining the progress of the district as regards the purity of its atmosphere, when the observations have been continued in one town or city over a period of some years

The final proof that the observations are worth making and will prove of permanent value is, that the present head of the British Meteorological Office (Dr W N Shaw) would not have accepted the chairmanship of the Air Pollution Committee, unless convinced of the importance of the work which it is proposed to carry out.

The following is the official description of the apparatus which has been selected for making these observations, and of its method of use: The principle of the apparatus and method is the collection of the rainfall in an enlarged rain gage, and the separation from the collected water of the solid impurities which it carries down and retains either in suspension or in solution. The standard gage consists of a galvanized iron stand, supporting a circular enameled iron gage vessel of four square feet superficial area. Projecting above the gage vessel is a wire screen open at the top, intended to prevent birds from settling on the edge of the vessel The gage vessel is conical at the bottom and communicates, by means of a glass tube and rubber connection, with a group of three or more bottles connected together, and designed to hold one month's rainfall The rain and deposited matter falling on the gage are collected in the bottom, and are removed once a month for analysis Fig. 3 shows the gage used for the investigation of London's soot-fall, carried out in 1910-1911 The results of this investigation were referred to in the introduction to this article.

The instructions for use of this standard gage state that it is to be placed if possible on the ground-level in open spaces free from abnormal dust and wind eddies, and that the bottles containing the water and deposit are to be removed on the last day of each month, and replaced by thoroughly clean empty bottles Before removing the bottles, a brush and a rubber squeegee of standard pattern are to be used to remove any adherent matter. A chemical analysis of the water and deposit is then to be made by a standard method, details of which will be provided by the committee, and a report of the results obtained is to be sent monthly to the central office of the committee in London. At the end of twelve months, the Central London Committee will tabulate all the observations, and will issue their report giving the figures in an easily comparable form. The method, it may be stated, was only selected by the committee after all the known methods had been subjected to careful examination, and the apparatus described above was considered to fulfill best the requirements of a cheap, durable and accurate means for determining the soot-and-dust-fall of large towns and cities.

As an illustration of what can be achieved by this method, a diagram (Fig. 1) is given above, showing the results of Inspector Fyfe's examination of the air of certain Scotch towns, in the winter months of 1910-1911. Wooden boxes, one foot square and one foot deep, were used for catching the soot-and-dust-fall in these observations, and although this method is crude and inaccurate, it serves to indicate the value of the information that will be obtained, by a more scientific application of the method over a wider area of observation. Fig. 2 represents a plan of standard soot-and-dust-gage, showing the catchment area.

The writer will conclude this article by expressing the hope that the scientists who are in charge of the smoke investigation now being carried out by the Department of Industrial Research of the University of Pittsburgh, may be able to co-operate in this movement for measuring the soot-and-dust-fall of our cities, and that they will commence observations with the standard apparatus and method, in New York, Pittsburgh, Chicago, and other towns and cities of the United States of America at an early date.

The author's thanks are due to the editor and publishers of *The Lancet*, London, and to Chief Inspector Fyfe of Glasgow for their permission to make use of Figs. 1 and 3 for the purpose of illustrating this article.

The Renewed Siege of the Antarctic

AFTER a lull following the return to civilization last year of the British and German expeditions, as well as the greater part of Mawson's Australian expedition, a vigorous renewal of south polar exploration is now on the cards. It is practically certain that three large and well-organized parties will sail for Antarctica this year, and there is talk of two or three others. The fact that nearly three thousand men have applied for places on one of these expeditions, many of them offering to pay handsomely for the privilege of facing perils and privations in the frozen wastes, is one of several tokens of the immense vogue that polar exploration is now enjoying, and signal proof that the love of adventure, which, whether confessed or not, is the mainspring of all such undertakings, is not decadent among men.

Recent additions to the Antarctic map have been made chiefly on the side of the continent nearest to Australia and New Zealand, where the region from the Ross Barrier and Queen Victoria Land southward to the pole has been explored by Scott, Shackleton, and Amundsen, and the long coast of Wilkes Land by Mawson and Wild. The principal operations of the new expeditions will be conducted elsewhere.

A British expedition under Mr. J. Foster Stackhouse is planning to explore King Edward VII Land, which lies on the east side of Ross Sea, and as much as possible of the coast extending eastward toward Graham Land—at present a long blank on our maps. Stackhouse regards his undertaking as a continuation of the work carried out by Capt. Scott, and has aroused some rather gratuitous criticism by his use of Scott's name in support of his plans. His contention is that his project was originally discussed with and approved by Capt. Scott, that he has acquired the ship "Discovery," built for Scott's first expedition, and that he proposes to explore a land which Scott discovered.

A large Austrian expedition, commanded by Dr. Felix König, an experienced mountaineer and polar explorer, will go south on the ship "Deutschland," which was used by Filchner's expedition. This party proposes to continue Filchner's exploration of the coast of Weddell Sea, and to establish a base on land, from which three long sledge journeys are to be made by different sections of the expedition; viz., to the south, east and west. No special emphasis appears to be laid upon reaching the pole, the principal object of the expedition being to explore thoroughly the now little-known Weddell Sea side of the continent.

The third expedition definitely planned for 1914 will be commanded by Sir Ernest Shackleton, and proposes to attempt the hazardous feat of crossing the Antarctic continent from the Atlantic to the Pacific coast, a distance of about 1,700 miles—as far as from New York city to Dallas, Texas. Shackleton himself has described his projected crossing as "a longer journey than to the pole and back and infinitely more difficult, because we shall always be advancing over new ground, with no depots to draw upon" It is possible, however, that the party will not have to depend entirely upon its own resources during the latter part of the journey, as it is planned to have an auxiliary expedition land on the coast of Ross Sea and sledge southward along a previously arranged meridian as far as latitude 83, if possible, to meet the explorers coming from the pole. The expedition will have two ships, driven by oil fuel, for the main and auxiliary parties respectively. The sledges, which will perhaps be constructed of steel tubing, will be drawn by dogs, except two, which will be driven by aeroplane propellers. Other novel features of the equipment are under consideration The expedition goes south next autumn, and Shackleton hopes to complete the transcontinental journey by the following spring, though the entire expedition is not to return before the spring of 1916. It is to be hoped that he will be more lucky than Filchner, who undertook in 1911-13 to make a very similar journey over the same route, but never even succeeded in getting ashore on the Antarctic continent.

At the International Geographical Congress, held last April, Dr. W. S. Bruce outlined the plans of a Scottish expedition, which also proposes to cross Antarctica from Weddell Sea to Ross Sea. A lack of funds appears to have prevented the maturing of this project, and, as far as we know, no announcement has yet been made as to when the expedition hopes to sail.

In regard to the extraordinary announcement in recent press dispatches that Louis de Rougemont, "the veteran explorer," will lead a large expedition to the Antarctic under the patronage of the Australian government, the only comment that need be made for the present is "Interesting if true." De Rougemont achieved notoriety in the year 1898 by a story of picturesque adventures in Australia, narrated at a meeting of the British Association, concerning the veracity of which a long controversy raged in the magazines and newspapers of the period.

A Modern Battle-practice Target

THE naval target shown on the cover of this issue gives a near view, which enables the reader to get a clear conception of the construction and various details of an object which ordinarily can be viewed by the layman only from a distance of many miles.

It will be noted that the target is of simple and rather crude construction. It consists of a submerged hull carrying a comparatively light superstructure. The superstructure of the target shown is thirty feet high by sixty feet long. Its height is therefore approximately the average height of a battleship above its water-line. The length is about one tenth of the overall length of a modern dreadnought.

The hull, or raft, is built up solid of 12-inch by 12-inch timbers, strongly bolted together; and it measures in length over all about 110 feet, in width about 5 feet 6 inches, in depth about 15 feet. The bottom of the hull is ballasted and to each end is attached a heavy chain bridle, to which is made fast the towing hawser.

The superstructure above the deck of the raft (the latter is ordinarily about awash) is the target proper. It consists of a number of stout uprights, across which is nailed a series of horizontal battens or strips of wood. Over this is drawn a net of rather coarse mesh, which is hauled up to the top of the uprights and then drawn taut by blocks and tackle attached to the bolt rope at the bottom of the net and to the deck.

The target is towed, usually, by a battleship, the distance from the ship to the target being ordinarily between three and four hundred yards. The ship that does the firing steams past the target, either in the same or the opposite direction to that in which the target is being towed, and "lets fly" at it. On the quarter deck of the towing ship is a group of officers who observe the fall of the shot. The splash of these is photographed, and, latterly, moving picture machines have been utilized to show exactly what takes place. After a ship has fired, the "seamen" lower a boat, row over to the raft, and take down the net, which is then spread out on the deck of the firing ship and the number of holes is counted.

The Current Supplement

IN this week's issue of the SCIENTIFIC AMERICAN SUPPLEMENT, F. Donaldson discusses the proper methods of sinking and lining shafts so as to avoid heavy fixed pumping expense after the completion of the mines.—G. A. Cromie, superintendent of trees, New Haven, reports on an unusual case of electrical injury to street trees.—A comparative estimate of the cost of power from coal and from solar radiation, based upon the performance of the plant in Egypt is published in this issue.—R. Thurston Kent, writing on economies in shop transportation, shows how loss of time between machine operations can be reduced by judicious equipment.—H. C. Plummer contributes an excellent article on the "Soo" Canal at the outlet of Lake Superior, where the world's greatest inland traffic by water passes.—F. A. Perret discusses the causes of the ascent of lava from the interior of the earth.—Most useful information on the causes of the bursting of flywheels and the proper methods to be adapted to provide safety against such accidents will be found in an article dealing with this subject.—H. L. White discusses the influence of bran extracts on the baking qualities of flour.—F. Oswald writes on the Sudden Origin of New Types.

Effect of Hydrochloric Acid on Silica

SOME very singular and unexplained effects of hydrochloric acid upon silica are brought out in M. Armand Gantier's paper recently read before the Académie des Sciences. In his recent experiments on this subject Gantier finds that the effect of the acid varies widely according to the form of the silica. In the shape of rock crystal, the acid attacks it but slightly. Some action can be detected when the crystal is cut parallel to the axis, but it is practically nothing upon the surface when cut across the axis. The reason for this difference is unknown as yet.

Radium in Cancer

Its Scope of Usetulness and Its Limitations

By Worthington Seaton Russell, M.D., Research Fellow and Chief of the X-ray Department, New York Skin and Cancer Hospital

Great have been the triumphs of medical science in recent years. Some of our worst foes—diphtheria, typhoid fever, small-pox, etc., have yielded to methods based upon modern bacteriology. Unfortunately the methods so successfully employed in the instances cited, fail completely in our fight against two of the worst enemies of mankind—tuberculosis and cancer. What then are we to do? Are we to fold our hands in our laps while awaiting the deliverer who shall free us from these bonds?

There is an old adage that prevention is better than cure. Where the prospect of a cure is at the best very uncertain, this truism acquires special significance, and thus the warfare against tuberculosis and cancer has been largely a warfare of education—the dissemination of knowledge regarding the causes and modes of transmission of these scourges. In the case of tuberculosis this mode of attack has been most fruitful of results. It has been the hope of the medical profession that something at least could also be accomplished in this way in the warfare against cancer. The people have been warned of the nature of the first indication of cancer and of the deadly danger incurred by delay in consulting a competent surgeon, or by failing to follow his advice when the knife must intervene.

It is to be greatly regretted that much of the good that such a campaign may have accomplished, must have been undone by the sensational newspaper accounts and scare headlines which have recently proclaimed alleged healing powers, little short of miraculous, for radium in the treatment of cancer.

The truth is that radium has for many years past been employed as a remedial agent against certain superficial growths somewhat akin to cancer, and that some good results have been obtained. But the field of usefulness for the substance has been quite limited, and there is at present no basis for the belief that recent developments so glaringly displayed in the newspapers will bring any immediate advances of a startling character. At the best many months, if not years, must elapse, before any certainty can be reached, and before the general public can profit by a new remedy which has not yet passed out of the experimental stage. In the meanwhile many may be misled by a false hope, or may defer the life-saving operation, and incalculable suffering may thus be caused.

It is with these facts in mind that we gladly open our columns to a statement from the pen of Dr. Worthington Seaton Russell, an expert in the field of cancer treatment and research, who, in answer to many inquiries received at the hospital to which he is attached, has made an authoritative statement for publication in the Scientific American *and the Crouse-Irving Bulletin, regarding the present situation.*—Editor.

RECENTLY the daily press has extensively exploited the alleged claims of two well-known members of the medical profession that in radium has been found the long-sought-for cure for cancer.

Articles have appeared in the leading newspapers of all sections of the country, a sample of which I have before me in a clipping from a Syracuse paper with the very positive and convincing headline, "Radium Rays Cure Cancer in Forty-eight Hours," and again in the text, "Cancer is curable and cancerous growths which had resisted every other treatment invented by science *have been cured in forty-eight hours* by the marvelous properties of radium." The italics are mine.

Many "sure cures" for cancer have arisen, owing in great part to the publicity of the subject following an effort of the profession to properly educate the public regarding the importance of an early diagnosis and prompt and proper treatment. There is but one universally recognized cure for cancer—the knife. Those competent to speak authoritatively because of experience with the various methods of treating cancer are unanimously agreed that the early, complete and radical operation is the safest method known to the profession at the present time.

Just as the earnest efforts of those interested in the popular campaign against cancer are beginning to bear fruit and our patients are realising the necessity of operation, comes the positive statement, heralded all over the country, that the dread disease can be cured by radium. The statement is all the more harmful because it purports to come from eminent surgeons, and further because there is an element of truth in what has been reported.

This arousing in a credulous public of the false hope of a cure does incalculable harm. Many sufferers will defer operation until too late, hoping to avoid the use of the dreaded knife, others will spend hard-earned savings in an effort to receive the treatment and many other unfortunate victims will fall into the hands of the numerous quacks whose only claim to radium is in the use of the name in their advertisements. We hear the heart-rending story many times at the New York Skin and Cancer Hospital—the story of the trial, first of this cure, then of that, the eager and anxious waiting for the promised improvement, the consequent despair and the taking up again of the search for the "sure cure," which is never found, until finally the poor sufferer drifts into the hospital, demanding in the name of humanity that "something" be done to relieve the awful suffering. Everything possible is done, but with quite a different outcome than if the patient at the very outset had fallen into the hands of one competent to give advice.

It is not so long ago that we read in the papers of the long line of consumptives, hopeless yet always hopeful, anxiously awaiting the extensively advertised opening of an "institute" for the cure of tuberculosis by the use of a "turtle" vaccine. The doors never opened, and many a sufferer who had spent his last cent upon a long journey had to beg his way home, there to die because the exertion sapped the little vitality he had, and because of the realisation that he had been duped and there was no hope for him. There is no more damnable scheme than that which works upon the credulity of the incurable sick with the promise of a cure.

Now comes the cancer cure by radium. That radium has its field of usefulness in the treatment of certain conditions, particularly of benign growths, is not to be denied, but the statement of enthusiatic advocates that the radio-active material will cure cancer is to be challenged. A proper degree of enthusiasm is laudable, but only when it is tempered with scientific skepticism. Those who have had the most experience with radium are not prepared to state just what the effect is upon cancer. The crucial point is, just what may be considered a "cure" in cancer? We have seen many cases come to the hospital in which the primary growth had disappeared under radium irradiation, but with immense metastases appearing some months afterward. Is it justifiable to record and report such cases as cures? Decidedly no. A case cannot be said to be cured of cancer until five years have elapsed without a recurrence. We are testing many methods of treatment at the Skin and Cancer Hospital, but while we are getting interesting and encouraging results from some, we would not be dealing honestly with our patients nor with those who look to us for our opinions, if we made more positive statements for some time to come. This new method of employing the various radioactive substances in the treatment of cancer should be thoroughly, carefully and scientifically tested by those especially trained to carry on the correct technique, and then, after the proper period of time has elapsed to make the results of real value, a conservative report should be published with an estimate of the worth of the method.

The effect of radium cannot be correctly judged unless comparatively large amounts of high radioactivity are employed and unless the proper technique is used. The employment of a radium salt with a low activity, although the bulk may be large, will not produce results. It is said that one surgeon who was using a considerable quantity of a "radium preparation" without result had it tested by a reliable expert, and was told there was no trace of radium whatever in the material.

For several years Dr. Bainbridge, director of the Cancer Research Department at the New York Skin and Cancer Hospital, and I have visited the Laboratoire Biologique du Radium at Paris, the London Radium Institute and the other institutions using radium, with a view to watching the work they have been doing. The Paris Laboratory is one of the most important, at the same time being the oldest institution devoted exclusively to the use of radium.

We have been using radium at the Skin and Cancer Hospital and are acquiring a larger quantity of a high activity in order to give the method a thorough test.

Drs. Wickham and Degrais, who have been in charge of the Paris Laboratory, read a paper at the International Congress held in London last summer on "Can Radium Help Surgery in the Treatment of Malignant Tumors?" from which paper I will quote some of the writers' views. They advocate operation in all operable cases to be followed by application of radium if a recurrence is to be feared. In those cases in which the growth is difficult of operation they advise radium treatment both before and after the operation. Several investigators have claimed that radium may in some instances convert an inoperable growth into an operable one.

The authors admit that radium has only a local and palliative effect, still in certain cases of cancer a state of apparent cure has remained for several years.

The London Radium Institute was opened in August, 1911, and the first report appeared in the early part of last year. The Institute has the largest quantity of radium of any in the world, and therefore it has not been limited in its work for a lack of the material. The report, therefore, is of value, especially as Dr. Pinch, the medical superintendent, is careful in his attitude toward the method. A total number of from six to seven hundred cases were treated, including 134 patients suffering from epithelioma. Of this number 7 were "apparently cured," 39 decidedly improved, 22 died, 20 showed no improvement, 23 abandoned treatment, 15 received prophylactic raying, and 8 were too recent to be classified. We must exclude those cases that discontinued treatment, those that received the prophylactic raying and the recent cases, leaving a total of 88. Of this number 25 per cent died, while there was cure or improvement in 52 per cent. The report advises operation in all operable cases. The results in cancer of the rectum were not as favorable, although it is claimed that in some instances the growth diminished in size, making it possible to remove the tumor by surgical means.

The most successful treatment was with rodent ulcer, an almost non-malignant affection. Dr Pinch states in the report, "Rodent ulcer is, of all the forms of malignant diseases, the one which is most amenable to the action of radium"

The prophylactic irradiation was employed as a post-operative procedure, and of those so treated only a few showed recurrence. There is a fibrous transformation which serves to arrest hemorrhage and to prevent the dissemination of cancer cells by sealing the lymph vessels.

It must be remembered in analyzing the report that only the most hopeless cases apply for relief and further that Dr. Pinch has classified as "apparently cured" those cases that present a "condition in which all traces of the original lesion have disappeared, in which there is no sign of recurrence and in which the patient is free from any external indication or symptom of the disease."

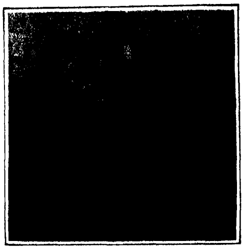
Dr. Knox, in charge of the radium treatment at the London Cancer Hospital, finds that "operation gives the safest, surest and quickest results in all cases of early cancer, but that radium should be used as a useful adjunct following operation." In common with many observers he states that the X-ray may be as useful as radium. The one advantage that radium has over the X-ray is that several tubes containing the radium may be buried in the substance of a growth and left there for a long period of time.

One effect has been noted by some observers, and that is that where a primary growth has been rayed the recurrences which appear on the same site are much more resistant to further action of the radium than was the primary lesion or the secondary tumors which may occur outside the field of the first raying.

I have purposely said nothing of the universal success in the treatment of *benign* conditions, as keloid, nævus, angioma and the like; here one can speak enthusiastically enough, but these facts are well known to the profession.

Except in the case of superficial epitheliomata without secondary involvement and in certain forms of sarcomata, which are not very malignant, there is no warrant in proclaiming radium as a cure for *malignant* tumors.

At the annual meeting of the New York State Medical Society last spring, an enthusiast, in speaking of the use of radium, stated that if he had a sufficient quantity he would transcend the acts of the days of the apostles. I can second Dr. Bainbridge, who replied that he, too, had been fired by the same enthusiasm, but after repeatedly visiting the European centers where radium was being tested, he had seen nothing to prove that we had a new specific remedy for cancer

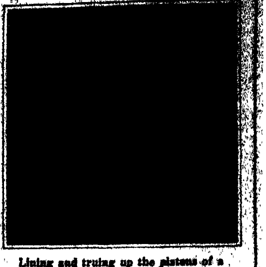


Selecting connecting rods in sets of uniform weight.

Going Through the Shops—III

The Associate Editor of the Scientific American Witnesses Some of the Methods Used in Obtaining Extreme Accuracy in High Grade Motor Cars

By A. Russell Bond

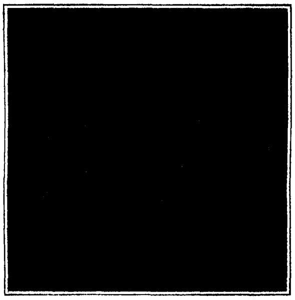


Lining and truing up the pistons of a six-cylinder motor.

THE paper upon which the SCIENTIFIC AMERICAN is printed measures three one-thousandths of an inch in thickness, a measure too small to be observed with the naked eye Yet an automobile manufacturer would hold up his hands in horror if you showed him a piston or cylinder that varied from his stardard by anywhere near that amount Split this paper into six leaves; wrap one of the leaves around a piston of standard measure and you will have increased its diameter by only one one-thousandth of an inch. If then you could insert this piston into its cylinder, the cylinder would probably be rejected as too large, or if accepted, you would be informed that it represents the absolute limit of departure from perfect accuracy. We are accustomed to saying that there must not be a variation of a hair's breadth, believing that to be the acme of accuracy, but a hair's breadth may be three one-thousandths of an inch or more, whereas in the important part of an automobile motor, one one-thousandth of an inch represents the extreme variation permissible in the more important parts of an automobile motor, and some parts have to be ground down to within half of a thousandth of an inch. A common method of testing cylinders is to provide two plug gages, one of them marked "go" and the other "no go" If you pick up these gages you will note that the exact diameter of each is given down to the thousandth part of an inch and that the plug marked "no go" is but one one-thousandth of an inch larger in diameter than the other. The cylinder must be finished to such a size that the "go" plug will enter it and the "no go" plug will not.

An essential part of every automobile factory is the maintenance of micrometers and test gages Thousands of dollars are spent on the gage equipment. A machine cannot be depended upon to cut the work with perfect accuracy, for the cutting tools are bound to wear. Furthermore, a tool, even on a finishing cut, does not leave a perfectly smooth surface. Some manufacturers believe it desirable to leave a mat surface on the inner wall of the cylinder, so that it will hold a film of oil. Other manufacturers believe in grinding both the cylinder and the piston to a perfect fit. While the cutting tools cannot be maintained to a perfect standard of accuracy because of wear, the same is true, although in a far less degree, of the gages Some manufacturers depend upon micrometers and gages made by manufacturers of precision instruments. Others, not satisfied with that, go to the extreme of using master gages with which their micrometers are tested from time to time. These master gages are rectangular pieces of metal, with perfectly true faces and conceded to be the most accurate pieces of mechanical work in the world. Their accuracy is guaranteed to the ten thousandth part of an inch. If two of these pieces be rubbed together to remove the film of air between them they will fit so perfectly as to adhere tenaciously. With such master gages as these, the micrometers are tested from time to time and corrected, and with these micrometers the various gages of the machine shop are in turn tested and kept in perfect condition.

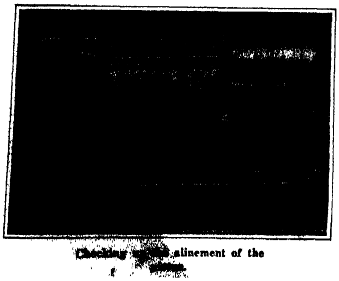
The automobile engine is a high speed machine, and it is absolutely essential to have perfectly fitting parts, for, with the piston reciprocating a thousand times a minute, the slightest looseness would soon develop into serious wear, loss of power and eventually breakage of parts. Of course, no matter how perfect the fit of a piston in its cylinder, it is necessary to use piston rings to prevent leakage of the high pressure gases. To form these rings so that they will bear evenly on all parts of the cylinder while in operation calls for expert designing. One of the accompanying illustrations shows a fatigue test to which certain piston rings are subjected. The piston rings are cut from a cylinder or "pipe." In order to determine whether the piston ring has the requisite amount of resiliency a sample is taken from each pipe and the ring is held open by a suspended weight of about 12 pounds, as shown in the photograph. The sample tested is always the first ring cut, which is looked upon with the most suspicion. The rest of the rings are supported on a peg above the one that is being tested. The 12-pound weight must bring the ring open about 1¼ inches. In that position it is held for twenty-four hours, and then when the weight is removed it must spring back to within 3/16 of an inch. If it fails in this fatigue test, all the rings from the same pipe are thrown out. Not only must there be a perfect fit of the piston in the cylinder, but there must be perfect alinement of the piston in relation to the crank shaft bearing of the connecting rod. One of our illustrations shows a gage used for this purpose. The connecting rod with its piston is supported in the gage with the crank shaft bearing fitted upon a mandrel. A gage lever is then pressed against the side of the piston, and if there is any variation from correct alinement, the variation is shown by a pointer that multiplies the slightest discrepancy. In this alinement gage no variation is permitted, but the pointer must register exactly on the zero point. To determine whether the connecting rod has become bent or twisted ever so slightly another gage is used with which the variation is shown by a multiplying lever, and if it is more than one one-thousandth of an inch the connecting rod is rejected. In order to balance the parts perfectly the pistons and connecting rods of each engine must weigh alike. At the top of the page may be seen a man weighing connecting rods and assembling them in groups of six of equal weight for a six-cylinder engine. At the opposite side of the page may be seen the method of lining and truing up the pistons of a six-cylinder engine.



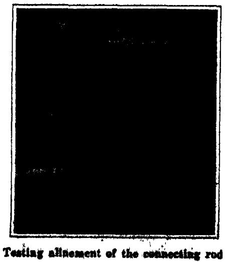
Piston rings undergoing a fatigue test.

The crank shaft is another element of the machine that requires perfect balancing. The shaft is mounted on knife edges, so that if there is any preponderance of weight in any of the crank offsets, the fact will be determined by the turning of the shaft. Not until a shaft has been so balanced that it will maintain itself stationary when turned to any angle, is it accepted for service in an automobile. No less important is the cam shaft. Our illustration shows two tests to which the shafts are subjected. In one of them the bearings of the shaft are being gaged to see if they are true, or if any eccentricity has developed in grinding them. In the other test the relative positions of the cam swells are being gaged. The wheel at the end of the shaft is indexed, and as the different cams are fitted into the gage block the pointer shows on the index whether the swells bear the proper angular relation.

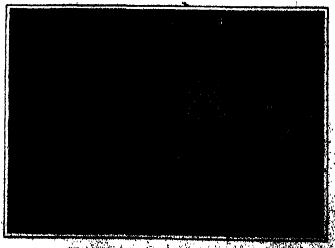
Outside of the motor proper more attention must be given to the gears than any other one part. Spur gears may be cut very accurately, and if necessary ground after being hardened. To test the gears it is customary to revolve them in mesh with a master gear, then the play of the gears toward and from each other, if there be any eccentricity, may be detected by watching an index mark through a magnifying glass. Bevel gears, however, present a more serious problem, for the reason that the cutting of the gears is a complicated process. If the gear is to be hardened after the teeth have been cut, it is sure to be warped out of shape and must be straightened in a press. It is impossible to grind the teeth perfectly true, owing to their tapering shape, and so, if noise is to be avoided, it is customary



Checking up the alinement of the piston.



Testing alinement of the connecting rod bearings.



Weighing the reciprocating parts of a motor.

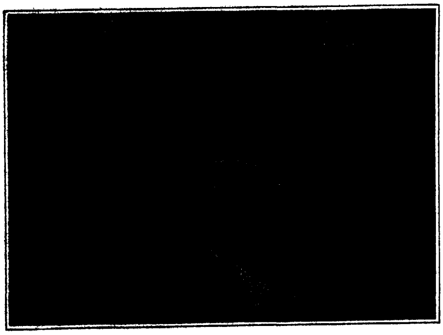
[illegible] they are then [illegible] and passed on to the assembly department.

To avoid noise in spur gears, spiral-toothed gears are largely used. One manufacturer has developed a similar method of overcoming noise in bevel gears. The teeth of the bevel wheel are given a spiral form, so that there is a more continuous engagement of the teeth, and even should the teeth not fit as perfectly as those of a well-matched pair of straight bevel gears they will mesh with practically no noise.

Quiet running is a mark of high-grade workmanship. Special types of engines have been invented to reduce noise, but manufacturers of the standard type find that by using special refinements here and there and a higher class of workmanship, much of the noise that used to be considered essential in the poppet valve motor may be eliminated. One of our illustrations shows the care with which high-grade motors are tested. The engine has gone through the usual test, running many hours under a partial load until all the parts have eased up and are working smoothly. Now it is taken into a room apart, where all noise is excluded. An inspector then goes over the machine with a stethoscope, just as the physician examines the human motor, and he searches for the slightest scraping, throbbing or knocking in any part of the engine which might indicate tightness or looseness. Not until the motor physician is satisfied that every part is working with perfect smoothness is the engine turned over to the assembly department, there to be mounted in the chassis with the transmission gear and run again on a dynamometer test, or on a road test around a specially prepared testing track. Finally after everything has been done to develop latent symptoms of trouble, the body is mounted on the machine, and the finished automobile emerges from the factory.

Hunting for eccentricity in the cam shaft bearings.

Checking up the angular location of the cam swells.



The motor physician hunting for trouble with a stethoscope.

A Folding Wheel-Chair

THERE is no problem in life that is not fit material for the work of the inventor, and many are the situations where the contriver comes to the aid of nature and supplies some comfort or necessity, which tends to lessen the misfortunes of humanity. A case which solves this is shown in the construction of a folding invalid wheel chair. A merchant of New York has an invalid daughter, who, because of an accident, was rendered unable to walk. The girl had at her disposal her father's automobiles, but there was the disadvantage that unless a wheel-chair was provided at the *other end of* the trip the girl could not leave the car, as the only way she could move around from place to place was to be assisted about in a wheel-chair or perambulator. The ordinary wheel-chair was too large and clumsy to go into the body of the automobile, and the girl was forced to remain at home.

The father wrote to various companies to find out whether they would not undertake the construction of a folding chair, such that it could be folded up and stowed in the body of an automobile. None of the companies that manufacture wheel-chairs was willing to undertake such a vehicle, as it did not seem practical.

But by chance, at one of the wheel-chair factories, a new superintendent, in looking over old orders, came upon the letter of the merchant concerning the building of a special folding wheel-chair. The superintendent was at once interested, as it happened that he, too, had an invalid daughter who was unable to walk. Believing that such a folding structure was possible, he obtained permission to attempt the construction of one, the success of which is shown in the following description of the device:

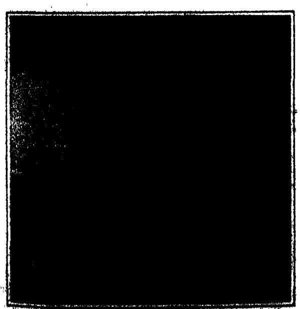
The frame of the chair is made of seamless steel tubing, bent at the corners in graceful curves, and upon this framework is fastened the wooden body, which is made of thin veneer about half an inch thick. The whole body is upholstered in a gray corduroy and is very comfortable when one considers the weight and the space involved. The finish is in maroon enamel and nickel trimmings to match the automobile in which it is carried. The wheels are of the bicycle type with solid rubber tires and ball-bearings. The hubs are made especially narrow to provide for closing into a small space.

Some idea of the folding qualities can be gathered from the fact that the chair folds from 48 inches in height, when "set up," down to 13 inches. From front to rear it folds from 38 inches to about 30 inches, while in width it does not decrease at all, but remains at about 20 inches.

In folding, the chair rolls up somewhat like a bolt of cloth. First of all the sides or arms are folded inward toward each other. Then the back is folded forward and down, and the handle on top of it. Then the braces that hold the wheels are released. The small side boards at the foot are folded toward each other, and the foot-board with the small front wheels attached is folded up against the front of the chair. Then the whole front part of the chair with the foot-board and the wheels, is folded upward and parallel to the back. The large wheels are then closed toward each other and a strap is passed about the whole, and it is ready for carriage.

The weight of the chair is about 70 pounds, which is not any more than the ordinary non-collapsible article. Due to the small space occupied when shut up, no difficulty is experienced by a single person in carrying the device. Folding or unfolding can be accomplished by one person alone in from 30 to 40 seconds.

The chair was forwarded on completion to the merchant, and it fully met with his approval.



Testing gears for concentricity.

Mating bevel gears to run without noise.

Testing noiseless spiral bevel gears.

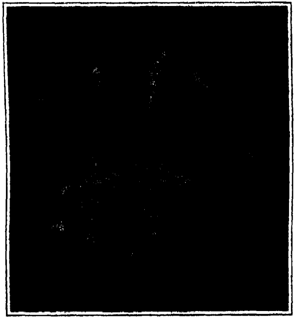
Farm for Jungle Folk

Feeding the Animals of a Zoo and What it Means

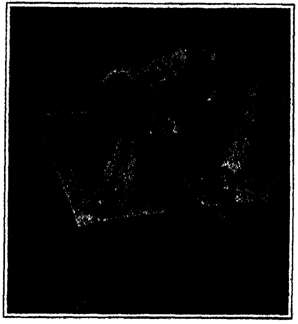
ONE of the most novel and least known agricultural and live stock enterprises probably in New York is the Jungle Farm, where the food is raised for more than five thousand animals, birds, and reptiles, exhibited in the New York Zoological Park. Its output includes everything from young pigs for the big python to lettuce, celery, raspberries, strawberries, honey, etc., for the smaller denizens of the cages. It is located in a secluded valley in Bronxdale, east of the Bronx River, between Boston Road and White Plains Avenue, a quarter of a mile distant from the great highways of travel. It covers six acres of land, and is one of the most essential parts of the complex machinery for the maintenance of the zoological collection, the largest in the world. The superintendent of the Jungle Farm is Mr. Earnest Costain, who has a dozen or so of men to assist him in carrying on his work. The more than 1,000 different species of wild creatures in captivity in the Zoological Park have possibly a wider range of appetite than the throngs of people catered to by a great metropolitan hotel. The farm produces all the various favorite food-stuffs, such as corn, carrots, beets, cabbages, turnips, mangels, and other things to delight the appetite of the vegetarians among the jungle folk. The several breeding houses raise chickens, rabbits, guinea pigs, rats, mice, pigeons and squabs by the thousands for use of the carnivorous birds and big serpents. This great outdoor plant for the feeding of wild things from the ends of the earth was established because the open market could not be depended upon to furnish the large and varied list of foodstuffs required to satisfy the finicky tastes of these feathered, furry and scaled captive boarders from every clime. Their food tastes differ far more widely than those of a collection of the races of the earth. Aside from the necessity of keeping these valuable living specimens in perfect health, as far as that can be done by a carefully studied diet, the Zoological Park has found that it saves about fifty per cent in the cost of furnishing the supplies. Further than that, there is never a chance of shortage, as a great reserve stock of food of all sorts is kept constantly on hand. Every day a wagon takes over to the Zoological Park from the "Nursery," as the Jungle Farm is officially called, a big assorted load of fresh vegetables and fruit for the hungry boarders. Piled on top are the boxes containing the day's supply of chickens, guinea pigs, rats, mice, and other choice morsels for the meat eaters. The vultures, hawks and owls and other such sharp-beaked birds of prey know almost to the minute when their rations are due. Everything has to be absolutely hygienically clean. This is especially the case regarding the animal food furnished the carnivorous birds, animals, and reptiles. Infection of every sort is guarded against most carefully, for every specimen in the great park has a definite value. Some of the birds and beasts are priceless and have cost much money and the risk of many lives to secure. Owing largely to the care that is exercised in growing the food for the great collection of living creatures in the Zoological Park, and to the skill with which it is prepared and served, cases of illness among the "boarders" are very rare. The daily supply of vegetables and rations that comes from the farm is deposited with the cook, who weighs and arranges them in piles. The keepers then come with their push carts and load up their allotted rations and return to the various buildings to feed the animals. Here is a list of the number of livestock and quantities of vegetables that were raised last year and fed to the great army of housed animals and birds: 105 pigeons, 16 ducks, 2,600 chickens, 1,103 rabbits, 1,283 guineas, 762 mice, 2,735 rats, 2,000 worms, 22,958 eggs, 25 pounds honey, 44 pigs, 50 sparrows, 150 pounds grapes, 50 bushels chickweed, 60 quarts of strawberries, 20 tons mangels, 900 bushels beets, 30 barrels potatoes, 1,500 roots celery, 3,000 lettuce, 2,000 cabbage, 5,000 ears corn, 2 tons cornstalks, 40 bushels tomatoes, 29 bushels turnips, 50 quarts raspberries.

For most of the large carnivorous animals the meat is not cooked, but fed raw. For a change, several horses a week, after being pronounced fresh and healthy by the veterinarian, are also slaughtered and added to the meat courses. The food for the great collection of reptiles, giant pythons, cobras, boas and others, demands a special care. One of the largest and most showy of the inmates of the Reptile House is the huge regal python, nearly 24 feet long and weighing over 200 pounds. This mighty serpent possesses a color-pattern of a richness that rivals oriental tapestry, together with an iridescence which gleams in all the highlights of its folds. During the first few months of confinement very large specimens of this snake appear to suffer from the restraints of captivity. They steadily refuse food, and if energetic measures are not employed, they become emanciated, and gradually starve to death. Whenever the big python is found languishing and approaching toward a suicidal end, it is necessary to feed it by force, and thus either awaken or counteract its sluggish appetite. Young rabbits are killed and tied together with brown twine, the snake is held by the keepers in as straight a position as possible, when by means of a pole the meal is forced down its throat a distance of about six feet, and offering a novel and spectacular performance. Food thus administered usually changes the snake's demeanor toward captivity. With the meal once digested, there comes an appetite for food, which usually can be detected by the snake's actions, although for a time the reptile may lack sufficient courage to feed voluntarily. Careful attention on the part of the keeper is usually successful, and renders a repetition of compulsory feeding unnecessary. At present there is great relief to the keepers of the Reptile House as the giant python is feeding voluntarily on a 35-pound freshly killed pig. This meal is sufficient for several months. The king cobra is a cannibalistic species, in captivity usually refusing everything but snakes. Most of the other serpents, alligators, lizards, etc., feed upon young chicks, pigeons, rabbits, guinea pigs, rodents, all freshly killed, and devoured whole. Eggs are also swallowed entire.

Thousands of white rats are raised and fed to serpents and large birds of prey.



Very young chicks, a dainty meal for snakes, alligators, or lizards.



Rabbits bred on the Jungle Farm are fed to the big pythons and other snakes.

The Cleaning of Scientific Instruments Composed of Glass

By Albert B. Owens

IN making accurate estimations involving measuring certain fixed volumes of fluids, the perfect drainage of the fluid from the walls of tubes and flasks is a point that cannot be overlooked in exact measurements.

When the walls of a burette or flask show drops of fluid adhering after emptying them, it is a certain sign that they are not clean. This is due either to the presence of fatty, oily, or resin substances often too minute for the eye to detect.

In order to overcome this difficulty the flask or tube should be treated with the following solutions in this order:

To remove saponifiable oils (vegetable or animal origin):

1,000 cubic centimeters alcohol 95 per cent (denatured or straight ethyl).
100 cubic centimeters water.
100 grammes caustic potash.

This formula is made by dissolving the alkali in the water first and then mixing it with the alcohol. Allow this solution to act one hour, then return to stock bottle and wash instrument thoroughly with water.

To remove resinous matter such as varnish, shellac, etc.:

500 cubic centimeters acetone.
200 cubic centimeters ether.
100 cubic centimeters coal tar benzole.

This will prove very effective, in about 30 minutes, depending on the thickness of the film.

To remove deposits of carbon, left as residues from distillation in the bottom of test tubes, flasks, and retorts from oil and tar distillations:

1,000 cubic centimeters hot water.
200 grammes potassium bichromate.

Stir until the bichromate dissolves, then cool, and add gradually with constant stirring 900 cubic centimeters of cold, strong commercial sulphuric acid. To clean with this solution, half fill the flask to be cleaned with the bichromate mixture, and rapidly heat to boiling over a Bunsen flame. A rapid oxidation of all the carbonaceous matter occurs, the bichromate solution being reduced to a bright green color, and all of the carbon removed. This method of cleaning should be used after the other two methods fail to effect their object. There are of course other powerful cleaning agents like fuming sulphuric acid, but they are not common in most laboratories, and are expensive.

Forcing Strawberry Plants by Means of Ether Vapors

AMONG the several methods of forcing plants, hot-baths have been used with excellent results, but quicker and better results may be reached by submitting the plants to the vapors of ether. It is not very long since this treatment of the plants has been put in practice in hothouses, but so far it has always given excellent results.

Mr. G. Bultel, a French horticulturist, writes the *Revue Scientifique*, has utilized this method for forcing strawberry plants, and in each and every instance, the plants so treated have borne berries far in advance of those untreated.

His latest experience, made in the winter of 1911-1912, was with 600 plants, of which 300 were treated with ether vapor and 300 with hot baths. The 300 etherized plants were divided into two lots of 150 each. One lot was exposed to the vapors of ether in a closed house for forty-eight hours. The other was subjected to the same anesthetic for sixty hours. Notwithstanding the difference in length of treatment, the results were only slightly in favor of the plants subjected to the longer exposure.

The following table shows the results he obtained with both treated and untreated plants, showing the considerable difference between the two:

Number of plants.	Untreated.	Treated.
Blooming on January 8th, 1912	88	197
Blooming ended	January 29	January 16
First maturity	March 6	February 21
Last maturity	April 15	March 15

The exposure of the plants to the fumes of ether shows therefore a very decided improvement upon the earlier productiveness of the plants, and should be therefore of great advantage to the grower.

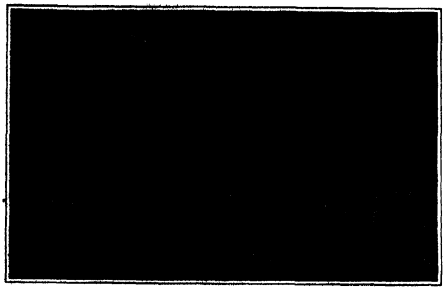
A Non-sinkable Mattress

IT is not a flood disaster that is depicted in the accompanying photograph; not an unfortunate victim washed out into the river, bed and all; but merely a striking demonstration of a new unsinkable mattress. The bed with a mattress arranged that so it is floating down the River Seine, Paris, in the presence of thousands gathered on the Pont Sully. A special buoyant fiber is used for the filling of the mattress. The inventor of this novel life preserver believes it essential for the equipment of every passenger-carrying vessel, so that in case of danger, one need merely pick up his own bed and use it as a raft. This novel demonstration was witnessed by the Assistant Secretary of Marine of France and a number of other officials.

A bed as a life raft.

A Razor That Chops the Beard

FOR the benefit of the man with heavy beard and tender skin a razor has been invented which cuts the beard by a chopping action. An electric motor is connected by a flexible shaft to the shaft of the safety razor. On the end of the razor shaft cylindrical cams are provided which change the rotating movement to a reciprocating one within the bladeholder. At the end of the holder this motion is again changed to one at right angles to the former, by means of a rocking arm and two prongs. Therefore the final motion of the blade is also a reciprocating one, causing the blade to act by means of blows against the hair. Many blows per second are administered, depending upon the revolutions per minute of the motor. The action of the blade is therefore not really one of merely cutting, but rather of severing by blows. The logical result is that it is not necessary to have the blades as sharp as it is now demanded. The chief advantage, however, is the rapidity with which a first-class shave can be accomplished, two to three minutes are sufficient. An application of soap is not necessary, wetting the skin will be sufficient. The sensation after the shave is very agreeable, resembling that of a mild massage. The motor may be connected by a plug with any lamp socket. It takes about 25 watts. The picture shows a combination set, the fan being intended for the use of the lady for drying her hair.



Vibrating razor that cuts the beard with a chopping action.

Laminated Gears

THE gear wheel has undergone but very slight changes in its production or design for many years past. Manufacturing methods are carried out upon either of two lines—casting, or cutting from solid blanks by machine. Both methods produce a very perfect wheel, and apparently are impossible of improvement.

Recently however an English inventor, Mr. A. E. Terry, a member of a well-known British engineering firm, has evolved an entirely new form of gear wheel, in the production of which also a new system of manufacture is employed. It is described as a laminated gear wheel. It is built up, but upon quite original lines. Instead of taking a solid blank of the required thickness, and machining the teeth, a number of thin disks of the desired metal are produced in an ordinary press, and the teeth on their peripheries are punched in accordance with requirements. These disks are then superimposed to the requisite thickness, and then clamped securely together by means of rivets, or bolts, producing a gear wheel as solid as that cut from a blank.

This is the elemental process and the disks can be fashioned from any suitable material, brass, mild steel, high tensile steel and so forth, at equal cost for labor. The rivet or bolt holes are punched simultaneously with the bore for the spindle, together with keyways or splineways, or they can be made to fit over a spider. The disks are then located on the tooth notching machine by the bore and the keyway, so that every other disk is identical as regards diameter of pitch circle, shape of teeth, and phase of the teeth relative to the keyway and bolt-holes. However, in building up the wheel each successive plate has its teeth phased one half tooth from its neighbor, the wheel thus comprising two distinct rows of teeth. This arrangement results in the halving of the virtual pitch and the doubling of the number of contacts.

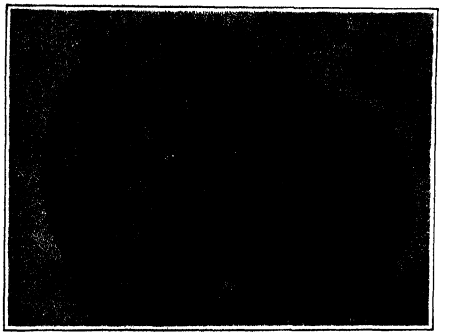
In the case of a large wheel the plates are mounted upon a spider, and bolted or riveted fast. The utilization of a spider allows a gear to be produced to any diameter, since the limiting factor is the spider and not the size of disks.

Should it be essential for the teeth of the laminated gears to be hardened there is no danger of distortion arising from the process, and subsequent grinding is not necessary. In hardening, the disks are packed on a mandrel to form a long pinion, with the teeth in line. Only the working faces of the teeth are hardened. The distortion of the disks is negligible, and when assembled, what little distortion may exist in regard to each individual plate, will not coincide with the rest, and hence it will be entirely neutralized.

The machines employed in cutting the disks are of standard design, while the dies, comprising a punch and die, to produce one tooth at a time, need neither an expenditure of considerable skill nor time in their preparation, and are not so costly as the cutters required for milling gears out of the solid. However, as the plate is in no way stressed while the operation of forming the teeth is taking place, there is nothing to disturb the location in any respect. Consequently, each disk is cut accurately.

In building up the wheel the disks are spaced apart by means of metal washers so as to leave a clearance for the teeth to pass without friction. From the searching and varied practical tests which have been made it has been ascertained that the laminated gear presents many advantages over that machined from the solid. It is practically as silent in running as raw-hide or silent chain drives because there is no hammering as each tooth comes into mesh, and because there is no "ring" in the wheel itself, this secondary sound being quite eliminated by the adoption of the lamination principle.

Another feature that cannot be overlooked is tooth fracture. In the laminated system this could only affect one or two plates, and would not throw the gear out of commission as is the case with a solid gear, while the defective disks may be readily replaced by dismantling the wheel.



Gear wheels made up of disks clamped together.

Disks used in laminated gears.

Libraries in an Indian State

THE very progressive native state of Baroda, in India, has no less than 275 public libraries connected with its Central *Library Department*, which was organized by Mr. W. A. Borden of New Haven, Connecticut. These contain about 156,000 books, and within the last three years the number of readers is said to have increased nearly 360 per cent. The department has also a system of traveling libraries, which remain at each village three months, after which fresh books are furnished; besides which each village gets a grant for the purchase of books for local libraries up to $100 a year, provided an equal amount is subscribed by the inhabitants. The central library, in the city of Baroda, will shortly open a special department for women readers. A visual instruction department to educate people who cannot read, and to promote knowledge of the outside world by means of stereoscopes and cinematographs, is also in operation. The Central Library Department of Baroda issues the only periodical in India devoted exclusively to library topics. The literary development of Baroda is further indicated by the fact that in the year 1910 there were about 200 books published by natives in this state.

A New Route to the Belgian Kongo

AN event of great economic and geographical importance will be the opening, early in 1914, of the extension of the present railway across German East Africa to Lake Tanganyika. The eastern terminus is Dar-es-Salam, on the Indian Ocean. At the lake end the Germans are building the port of Kigoma-Ujiji, from which a line of steamers will run to Albertville, in the Belgian Kongo, where a port is now being constructed under the supervision of Capt. Mauritzen, hydrographer of the Danish Navy. Albertville is the terminus of the Great Lakes Railway, which in a few years will connect with the other railways of the Belgian Kongo and with steamers on the Kongo River.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Pertaining to Apparel.

HOLDER.—J. MACDONALD, 218 W. 14th St., New York, N. Y. The invention refers to wardrobe fixtures, and provides a holder for neckties, buttons, scarf pins, coats, trousers, and other articles of wearing apparel and arranged for convenient attachment to a wall, wardrobe or the like, and for protecting the supported articles against dust.

Pertaining to Aviation.

AEROPLANE.—J. G. HANNA, 1215 S. Franklin St., Muncie, Ind. The purpose here is to provide a device for sustaining weight, and moving the same through air by atmospheric reaction on a curved surface or surfaces impelled either by a force of gravity or by mechanical power, and for insuring stability, great strength, and power of absolute control at all times.

Electrical Devices.

AUTOMATIC FUSE RESETTER.—J. B. ELKIN, 1802 Main St., Columbia, S. C. The main purpose here is to provide a device for use in connection with telegraph or telephone circuits for resetting fuses which have been burned out by lightning. A further object is to provide for automatically resetting any number of fuses, thereby obviating the necessity of setting the device after each operation, preparatory to the next.

Of Interest to Farmers.

ROTARY PLOW.—M. E. PLATFORD, Wakelee, Mich. This improvement has reference to plows, the more particular purpose being the provision of a so called "rotary plow" having spiral cutting blades so formed and fitted as to be specially adaptable for use in a motor plow. It can be readily assembled or taken apart for transportation or storage.

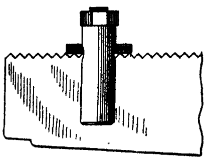
Of General Interest.

LIFE SAVING SUIT.—J. P. PARK, Beloit, Kan. Mr. Park's invention has reference to a suit more particularly designed to be worn by marine travelers in case of shipwreck. The suit is made from a suitable waterproof material and may be provided with a life preserver, or be adapted to receive an ordinary life preserver. The body of the suit is provided with legs and arms as shown in the accompanying illustration, the arms, if desired, having integral mitts.

LIFE SAVING SUIT.

Hardware and Tools.

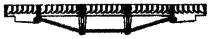
SAW JOINTER. F. M. BARNARD, Milford, Iowa. This invention is an improvement in saw jointers which is always ready for use and which may be used on any type of saw. The device is small and compact, and with the file removed may be easily carried in the pocket. With the file in place, it is firmly clamped so that it cannot be displaced by its engagement with the teeth and when any part of the file becomes worn, the file may be shifted longitudinally or turned until it is completely worn out.


SAW JOINTER

Heating and Lighting.

DAMPER CONTROLLING DEVICE.—F. A. KATELEY, 11 Wallace Ave., Mount Vernon, N. Y. The invention provides a device arranged to actuate the damper according to the pressure of the steam generated in the steam-heating apparatus, to prevent spilling of water in case of excess pressure in the apparatus, or in case a siphoning action takes place on forming a vacuum in the steam compartment of the steam heating apparatus.

GRATE BAR.—G. S. SERGEANT, Greensboro, N. C. This invention is an improvement particularly in grate bars made in sections held together end to end, and relates to means for supporting the sectional grate bar at the middle portion thereof. Means provide for employing the longest grate bars ever required without increasing the weight per linear inch, thus making the cost per linear inch no greater for long bars than for shorter lengths. Any style of grate surface and of vent can be employed to suit the various kinds of fuel which it may be desired to use.

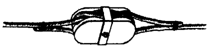

GRATE BAR.

Household Utilities.

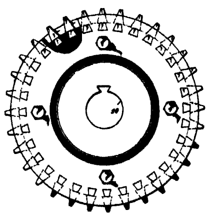
ICE CREAM FREEZER.—E. THOMPSON, 202 E. 46th St., New York, N. Y. In this device a circulating brine or similar freezing fluid is used as the freezing medium. The invention provides a freezer arranged to provide a large refrigerating surface, to avoid dormant nonfreezing surfaces, thus insuring a more rapid freezing and preventing deterioration in the texture and quality of the ice cream.

Machines and Mechanical Devices.

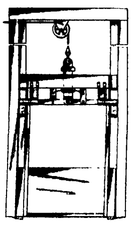
CLUTCH.—J. J. GILMARTIN, Guild, Tenn. Mr. Gilmartin's invention is an improvement in clutches, and has for its purpose to provide a clutch, especially adapted for splicing flexible members of metal, as for instance cables, ropes, and the like, wherein mechanism is provided for rigidly holding the ends of the cable together in the form of a square or reefing knot. With the use of the improved block there is no weakening of the cable at the knot.


CLUTCH FOR CABLES, ROPES, ETC.

GEAR WHEEL.—A. S. FINCH, 70 Henry St., Passaic, N. J. This invention provides a gear wheel having gear teeth dove tailed removably in the periphery of the body of the wheel with base extensions which are adapted to engage in openings in plates applied to the sides of the body of the wheel, whereby the said plates hold the gear teeth against lateral displacement and also afford additional securing and strengthening means for the teeth.


GEAR WHEEL.

SAFETY DEVICE FOR ELEVATORS.—M. C. HUTCHINGS, Bozeman, Mont. This invention provides a device for use with elevators, mine hoists and the like, which becomes operative instantly if the cable of the elevator becomes broken or relaxed, and which then serves to bring the elevator car to a stop before it can travel any material distance, which will in no manner interfere with the normal operation of the elevator, that cannot be inadvertently rendered operative when not needed, and which can be instantly automatically released after the grips have become operative.


SAFETY DEVICE FOR ELEVATORS

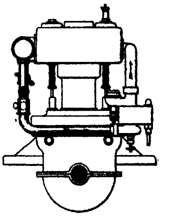
COAL CONVEYER.—O. S. BARNES, 403 Albemarle Road, Brooklyn, N. Y. This conveyer for handling coal or other articles of merchandise in bulk includes an endless series of buckets and adapted for free operation in any position of adjustment with respect to movement laterally around a vertical axis or with respect to vertical adjustment parallel to said axis.

ENVELOP OPENER.—W. N. BUSKIRK, Roanoke Ave., Riverhead, N. Y. In this patent the invention has reference to stationary articles and particularly to devices for opening envelops or the like by means of a cutter adapted to cut a slit closely parallel to one of the lateral edges or ends of the envelop.

STOP MOTION.—F. AINSWORTH, 877a Gates Ave., Brooklyn, N. Y. This stop motion is more especially designed for use on sewing machines and the like, and arranged to automatically stop the machine whenever the needle thread or the shuttle thread breaks or runs out, and to permit of conveniently applying the stop motion to sewing machines as now constructed.

Prime Movers and Their Accessories.

STARTER FOR INTERNAL COMBUSTION ENGINES.—S. G. BERRY, Tyndall, S. D. The invention refers to a starting construction for internal combustion engines, and the purpose is to provide a starter comprising a pipe connected to supply air warmed by the exhaust of the engine to the carbureter, and having means therein for vaporizing a sufficient quantity of gasoline independently of the carbureter in order to facilitate the starting of the engine in very cold weather.

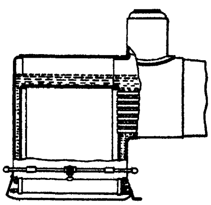

STARTER FOR INTERNAL COMBUSTION ENGINES.

GASKET AND RETAINER THEREFOR.—A. E. HART, 4 Fourth St., New Brighton, S. I., N. Y., N. Y. The intention here is to provide a structure designed to hold a gasket in place in an automatic air coupler under high pressure, the same co-acting with a high pressure air pipe and with resilient means for holding the coupler in a predetermined position for maintaining the gaskets of co-acting coupler heads in contact.

INTERNAL COMBUSTION ENGINE.—J. KERNER, Avenue d'Argenteul 266 Asneres, Paris, France. This invention relates more particularly to an engine of the two-cycle type which comprises a cylinder, a crank case closed with respect to the cylinder and a piston in the cylinder and having a piston rod intermittently effecting communication between the cylinder and the crank case.

Railways and Their Accessories.

AUTOMATIC MUD DRUM FOR BOILERS.—A. F. SHREVE, Hoisington, Kan. This invention relates to mud drums for boilers, the particular purpose being to provide a mud drum so constructed and arranged as to be automatic in the sense that it operates continuously and positively in the removal of mud and sediment from the boiler. The invention further relates to provision of means for removing the mud and sediment from the mud drum.


AUTOMATIC MUD DRUM FOR BOILERS.

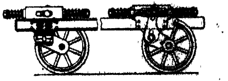
STORMPROOF CAR DOOR.—G. M. KIRBY, Aurora, Mo. The main object in this instance is to provide a door for a railway car or other inclosure that will be simple and practical in its construction, and so mounted as to make a perfectly stormproof covering for the doorway with which the same is to be used.

Pertaining to Recreation.

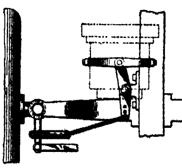
BATHING BOAT.—C. M. JOHNSON, care of A. Johns, 60 Wall St., New York, N. Y. This inventor provides a boat having a supporting section submergible at will, to form an inclosed bathing area arranged to prevent accident to the bather; provides a pleasure boat having a deck through [illegible] passes, and means for, [illegible] portion of the deck for [illegible] boat with a motor-actuated [illegible] and provides means for [illegible].

Pertaining to Vehicles.

VEHICLE SPRING SUSPENSION.—[illegible] BUSHEY, 180 Badger Ave., [illegible] This invention relates to an improved spring suspension which absorbs all shocks lengthwise and sidewise to the frame, and does away with the necessity of using pneumatic tires on motor cars. A mechanism is devised in which the vertical movement of the axle is yieldingly resisted on the frame, both when the frame and axle move toward each other and when away from each other, and the invention also provides a means for making the attachment between the frame and the axle more flexible by giving each individual wheel, or rather its ends of the axis, a limited movement without affecting the other end of the axle or the other wheel on the same end of the frame. Shock absorbing devices of this kind have been employed, but the present invention relates to the flexible attachment of each end of the axle to the body of the vehicle or the frame. In prior devices the shock absorbers in instances have been connected by transverse connections. In this invention each end of each axle is supported in a way that permits that end of the axle and the frame to have a relative movement without affecting the other end of the axle or the other axle.


VEHICLE SPRING SUSPENSION.

DIRIGIBLE HEADLIGHT.—A. C. HENDRY, care of Walter Scott, Davenport, N. Y. This invention relates to apparatus for connecting a headlight or headlights to a moving vehicle, having particular reference, however, to automobile headlights whereby at least one of the lights will be caused automatically to be steered in unison with the steering apparatus of the vehicle so as to illuminate the roadway in the direction in which the vehicle is to be operated at the turn.


DIRIGIBLE HEADLIGHT FOR AUTOMOBILES.

AUTOMOBILE TOP.—CARL V. BEEBE, Mount Gilead, Ohio. This invention relates to automobile tops comprising a canopy or curtain, and means for securing the curtain in position or for storing it when not required for use. The top can be placed in position with convenience and dispatch, and quickly and conveniently lowered and stored into small compass when not in use. The auto-top can be raised by an occupant without leaving the car and one can raise and lower it without assistance. The invention may also be employed in connection with other vehicles.

VEHICLE MOUNTING.—A. A. PRATT, 54 Wall St., New York, N. Y. The invention provides a mounting or suspension which is exceedingly sensitive and arranged to take up all jars and jolts incident to the vehicles traveling over rough roads, obstructions and the like, to insure easy and comfortable riding without requiring the use of pneumatic or similar tires, thus reducing tire expense to a minimum and eliminating danger and delay caused by bursting tires and the like.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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READ THIS COLUMN CAREFULLY. You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. *In every case it is necessary to give the number of the inquiry.* Where manufacturers do not respond promptly the inquiry may be repeated.

Munn & Co., Inc.

Inquiry No. 9340. Wanted the name and address of manufacturers of knock-down barrels, staves, hoops and heads which may readily be assembled.

Inquiry No. 9341. Wanted, mail order article. A man with long experience in the newspaper and advertising field desires to get in touch with the inventor or manufacturer of some quick-selling article, with the idea of inaugurating a Mail Order business to mutual profit.

Inquiry No. 9342. Wanted, a machine to cut No. 18 wire in 2½ inch lengths and sharpen both ends similar to tack points. One operation preferred.

Inquiry No. 9343. Wanted the name and address of manufacturers of machines for grinding the peel of oranges and grapefruit.

Inquiry No. 9344. Wanted name and address of manufacturers of patent articles of merit suitable for mail order distribution.

Inquiry No. 9345. Wanted name and address of manufacturers of Oxy-Acetylene Cutting and Welding Torch, also an easy opening can suitable for shoe polish.

Inquiry No. 9346. Wanted the name and address of parties manufacturing tobacco stripping machines, and other machines pertaining to cigar manufacturing and cigar banding machines.

Inquiry No. 9347. Wanted the name and address of an industrial school where shoemaking is taught in all its branches.

Inquiry No. 9348. Wanted the name and address of manufacturers having useful household necessities, with a view to obtaining exclusive territory for a house to house canvass.

Inquiry No. 9349. Wanted the names and addresses of the makers of machinery for making Malt Tonic, also a machine for making grease, and machines for applying plaster (Cement Gun).

MODERN ELECTRICS & MECHANICS
"The Magazine That is Different"

[illegible]

Notes for Inventors

A New Product in the Form of Butter.—Joseph Moses Ward Kimball, of East Orange, N. J., has secured a patent, No. 1,072,369, for manufactured and packed butter. This is defined as a butter that has been in a state of frigidity from the time it has been made to the time it reaches the consumer. By keeping the temperature below the freezing point proliferation of the germs in the butter is prevented. Still, the germs in the butter are in a state of vital inhibition and the butter is substantially free from objectionable flavors and odors due to the vital activity of germs.

Protecting the Baby's Head.—Belle G. Fitch, of Philadelphia, Pa., has patented a head protector for babies which has a single pneumatic tube of soft expansible material which fits around the head horizontally and has pairs of converging tubes which extend upwardly from the opposite sides of the horizontal tubes, with all of the tubes in communication with each other. The patent is numbered 1,072,321.

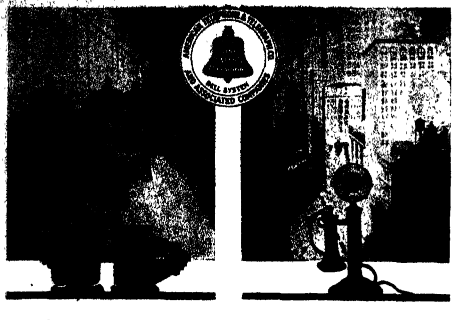
Toy Suggestions.—Two forms of toys appear to be more or less neglected at the present time. These are the airship toys which are projected and sail through the air, and the toy doll and animal figures carried on the hand and manipulated by the movements of the fingers. The airship toys present a field for improvement in the projecting devices and in the stabilizers and direction controlling features while in flight. Possibly the toys could be made to return boomerang fashion. The doll and animal figure toys present opportunities in the way of novelties in the design of the toy as well as in devices for facilitating manipulation to more nearly simulate the lifelike movements.

A Geographical Amusement Device.—In patent No. 1,070,546 to Hanson Robinson of Detroit, Mich., as assignee of John F. Sherlock and Henry Spengler of New York city, is presented a toy having a hollow globe with geographical markings and inclosing a magnet loosely mounted in the globe and counter-weights to preserve an upright position, and operates a keeper in the form of a ship on the outside of the globe so the ship by the turning of the globe can be made to appear to travel along any desired route.

A Gastronomic Clock.—A curious "gastronomic clock" is said to have been made in the old times by an ingenious Frenchman for telling the time in the dark. He installed a large flat clock dial beside the bed on which the hours each had a small cavity. In each one he placed a different spice, for instance, the figure 12 held quiqe and the figure 6 cloves, and so on. To find the time, he followed the short hand with the finger and then tasted the contents of the cavity opposite, then he did the same for the long hand, and had he pasted pepper and nutmeg, for instance, he knew that the hour was half-past three.

An Invention of the Future.—Thomas A. Edison is reported as saying that an improvement to be expected in the future is along the line of permitting the re-use of paper for newspaper purposes, by removing the printer's ink so the paper can be used a second time. Economy would be doubly served by such an invention as it would not only permit the re-use of the paper but might also lead to a recovery at least in part of the ink or ink particles for subsequent use if the ink should be removed from the paper.

Base Signal for Baseball Fields.—With the kindest of motives and in behalf of the poor umpire of a baseball game, Stephen H. Wills has invented a base for a baseball field which will give an alarm or signal when a runner reaches or touches it, thus avoiding the dispute which now commonly takes place between the runner and the umpire and the other members of the team as to whether or not the runner reached first base before the baseman caught the ball. This is accomplished by having the baseplate or bag hinged and raised at one edge by a spring. When the runner touches the base it is depressed, making an electrical contact which sounds the alarm or makes the signal. The number of the patent is 1,066,773.



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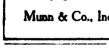

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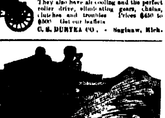

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Engineering as a Profession. Scope, Training and Opportunities for Advancement. By A. P. M. Fleming, M.I.E.E., and R. W. Bailey, Wh. Sc., Principal of the Technical Institute, Crewe. London: John Long, Limited, 1913. 8vo.; 288 pp. Price, 2s. 6d. net.

Knowing the proud position attained by the profession of engineering under the complex physical conditions of modern civilization, and having heard of the rich rewards many of its members have won, parents are too apt to overlook the prime necessaries of individual leaning and talent, and the arduous, skillfully-directed years of labor and learning that are indispensable to even a moderate success. The authors of this friendly guide are well qualified to disperse the prevailing ignorance that, failing to recognize what constitutes a suitable course of training, or to grasp the conditions surrounding engineering employment, practically invites ignominious failure in the chosen profession. The work in hand broadly reviews the various branches of this profession, tells exactly how the necessary training may be acquired and at what cost, with a special chapter devoted to the acquirement of such knowledge at a minimum expenditure, and discusses appointments in civil, mechanical, and electrical fields, with particular reference, of course, to Great Britain and her colonies. Under "Foreign Methods" is sketched the training of engineers by the German and American systems.

Wireless Telegraphy. By C. L. Fortesque, M.A. New York: G. P. Putnam's Sons, 1913. 16mo.; 143 pp.; illustrated. Price, 40 cents net.

This text is addressed to the reader having some general scientific knowledge, and deals with an important subject in a manner that is simple yet adequate to the purpose. The electrical phenomena involved are explained as far as possible by mechanical analogy. The principles of these phenomena are then applied to wireless apparatus, and the latter half of the little volume is given over to a survey of the most modern uses of the art. Marconi and Telefunken apparatus are clearly shown in illustrations, and the arrangement and operation of the instruments is thoroughly explained.

Addresses and Papers on Life Insurance and Other Subjects. By John F. Dryden. Newark, N. J.: The Prudential Insurance Company of America, 1909. 8vo.; 330 pp.

These papers deal with the inception, progress, and results of industrial and ordinary life insurance, and will prove of the highest value to those interested in the subject. The author was United States Senator from New Jersey from 1902 to 1907, and his senatorial utterances on the American type of Isthmian canal are included in the volume.

Pearls and Pearling. By Herbert H. Vertrees. New York: Fur News Publishing Company, 1913. 12mo.; 203 pp.; illustrated.

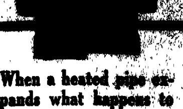
Few people realize that the United States has a well-established pearl industry—that, for example, in 1910 there were 2,600 pearling boats on the Illinois River, and that this is but one of many rivers that yield the pearl mussel. Mr. Vertrees' little book is a clear exposition of the methods and paraphernalia of sweet-water pearl hunting, and fills a gap in the literature of the subject. It also enters into the history and origin of the pearl, describes the life and habits of the mussel, and adds a description of the "cripple" in which the fine pearl is oftenest found. The values and uses of the various shells are listed, the reader is instructed in the art of prospecting, and the crow-foot dredging outfit and its manipulation is thoroughly described. There is, too, a study of the influence of local conditions upon the color of shells and pearls, and the luster of the pearl is explained. The manual is quite up to date in information and in methods, and not only affords the prospective pearl hunter invaluable information, but also interests the general reader in no small degree.

Seehafenbau. Von F. W. Otto Schulze, Professor des Wasserbaues an der Technischen Hochschule in Danzig. Band II. Ausbau der Seehäfen. Berlin: Wilhelm Ernst & Sohn, 1913. 8vo.; 523 pp.; mit 574 textabbildungen bestehend aus 957 Bildstocken. Preis des Werkes, Geh. 24.—M. Geb. 25.—M.

We mentioned favorably the first volume of Prof. Schulze's work on its appearance some time ago. Vol. II is an extension of the thorough studies of the first volume, carefully expounding harbor construction as exemplified in the harbors of the world. The various features of construction are progressively considered—breakwaters, moles, bulkheads, seawalls, wharves, piers, towers and structures pertaining to the loading and unloading of vessels, and the various types of crane, including the floating crane. There is a section also on excavators and dredges. By means of unstinted sketches every detail of plan and structure is distinctly shown. There is an exhaustive index covering both volumes.

The Physiography of the Rio Grande Valley, New Mexico, in Relation to Pueblo Culture. By Edgar Lee Hewett, Junius Henderson, and Wilfred William Robbins. Washington: Government Printing Office, 1913. 8vo.; 77 pp.; with maps and illustrations.

This bulletin is the result of two years' coöperative work by the School of American Archæology and the Bureau of American Ethnology, and consists of three papers on the Rio Grande Valley, its geology and topography, its climate and the evidence of [illegible]



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[illegible] Trained Men—IX

[illegible] in Iron and Steel Making

By S. T. Wellman

[illegible] Wellman, the author of the following article, has had a large part in the development of the iron and steel industry from small proportions just after the civil war to the enormous production of to-day. He is the inventor of a tilting open hearth furnace and of the charging machine which made the open hearth furnace [illegible]. Mr. Wellman has been general superintendent and engineer of the Otis Iron and Steel Company and president of the Wellman Seaver Morgan Company. He is past president of the American Society of Mechanical Engineers and of the Cleveland Engineering Society. He is a member of the American Institute of Mining Engineers, the American Iron and Steel Institute and of the British Iron and Steel Institute.—Editor.]

Is the profession of "Iron and Steel Making" a good one to follow? This is a question that is asked many times by young men who are trying to make up their minds as to their life's work.

The answer will depend very largely upon the man. Many would not like the business at all, and some, as I have seen them do, would turn and leave at the first sight of what the work and conditions are, saying: "None of that for me."

One young man that I remember many years ago, at his first sight of a Bessemer converter timing up, sending as it always does a shower of fire across the building, turned and fled headlong and never stepped inside the works again.

To me the iron business is the most fascinating in the world. All of the processes are interesting. New problems, mechanical and metallurgical, are constantly coming up to be solved.

There is plenty of room in the iron business for workers, but none for drones. The young man who adopts it for his life's work must have in the first place a good physique; he must be strong and healthy in mind and body, not afraid of work or dirty hands or rough clothes. He must expect at times to make long hours, when he is learning the business, and at times he will have a great deal of night work.

A college or technical school education is not absolutely necessary, but it is very desirable. The young man who starts in the business without such an education, must make up for the lack of it by a lot of self education at home, if he wishes ever to reach the top of the ladder. That it is possible to do this is shown by the careers of many of the brightest and most successful men in the business. Night and correspondence schools are open to the poor working boy who has the ambition to rise, and who is bound to learn all that is worth learning in his chosen profession. The very fact that he has to work hard in the face of all kinds of difficulties to learn what he is after, is the best kind of a beginning of a training for what is to come.

Many times, when asking professors at technical schools and colleges to send me graduates for different positions, I said to them: "Everything else being equal, I would rather have a poor boy who has worked his way through college than a rich man's son who doesn't know the value of a dollar, and whose chief reason for being at college is to have a good time."

The common opinion is that the poor boy is the one who is handicapped in making the race for real success in life. I am not sure but that this is wrong, and that it is very possible that the rich man's son, surrounded by every luxury, who lives in a beautiful home, with a doting mother watching over him, who never learns or knows the value of money, is the one to be pitied, and is really the boy who is handicapped.

The best assistant that I ever had was a young man who was the son of a barber. He graduated at the high school, after which he went to work in the office of an iron works of his native town. In a year or two he had saved five hundred dollars. With this and the addition of one thousand dollars which his employer loaned him, he went to Germany, where he stayed four years. This amount of money paid all his expenses. Of course, this was possible only by the exercise of the most rigid economy. He entered the University of Berlin, where he graduated, taking the highest honors that any American had taken up to that time. He spent all of [illegible] details of the business practically, but making many acquaintances that were valuable to him in after life. It is needless to say that he succeeded in everything that he took hold of. A man who goes at things in the enthusiastic way of this young man, is always sure to succeed.

A most excellent way for any young man to do who is trying to make up his mind whether he wants to learn and follow the iron business, is to spend one of his vacations, or a portion of it at least, in some steel works or rolling mill.

After this experience, if he makes up his mind that he wants to learn the business and follow it up as a profession, he can go back to school and go to work in earnest to learn any and everything that will help him in his chosen field of work.

I believe it is a most excellent plan for a student to spend at least a month of each year out of his vacation in some works, seeing the thoroughly practical side of the business. Every time after doing this, he will go back to college with fresh courage and a better understanding of what he needs to learn, and he will see how necessary the purely theoretical part of his education is.

Of course, no matter what profession a young man follows, one of the great advantages of a course at college is the associations and the acquaintances he makes there, which will always be pleasant and useful to him in after life.

When he has finished at college and obtained his coveted degree, he must not think that he is fitted to take charge of any works, or even a department of it. If he has sense, he will know that he is only learning the theory of things, but the hard practical part he has yet to learn.

A man who expects to be a leader in any business should know every detail. He should be able to take any workman's place for a short time. I don't mean to say that he should work at every branch of the trade long enough to become a first-class workman, but he should work at it long enough to get a thorough, practical understanding of it. If he does not do this and does come to a position of responsibility, not understanding the details in a practical way, the workmen will very soon find it out and they will be sure to take advantage of his ignorance.

Of course, if a young man goes into the iron business and expects to earn a living with his hands and muscles only, and to be merely a workman, skilled or unskilled, book knowledge will not help him very much. He might as well stop with a common school education. But if he wants to make his brains and not his hands do the work, he must get all the help possible from the best that books can teach. Of course the scientific school is the best place to do this.

Workmen who have a superintendent under whom they have learned their trade are more easily managed than if they had brought their trade with them, and its details are in any part a secret from the management. If they know that the superintendent knows just as much about it as they do themselves, they will know that, having taught them, he can teach others. Strikes are not likely to happen where the management is in such hands.

To my mind, the business of the ironmaster is the most interesting of any of the great professions. Every part of the work is full of the most interesting and picturesque detail, from the taking of the crude material from its bed in Mother Earth to the turning out of the finished iron and steel, and nowhere is it carried on in such magnificent scale as in this country in which we live.

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Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12910) P. R. B. asks: Please inform me if I can get through you any literature descriptive of the experiments by which the velocity of sound in water was determined. A. The velocity of sound through water was measured in 1826, by Colladon and Sturm in the water of Lake Geneva. A bell under water was struck, and at the same instant some gunpowder was flashed in the air above. At a station more than 13 kilometers (8 miles) away a sort of big ear-trumpet, closed by a membrane, was placed with the membrane under water, the tube rising above the surface. An observer with his ear at the tube noted the interval between the arrival of the flash and the sound. The velocity deduced at 8.1 deg. Cent. was 1435 meters per second, agreeing very closely with the calculated value. This account is taken from the Encyclopedia Britannica, eleventh edition, vol. 25, page 443C.

(12911) C. C. asks: Can you give me a simple and comparatively inexpensive formula that will remove fat or grease from enamel and porcelain "plates"? A. The best solvent for fat or grease is potash. This changes the fat into soap and it is then easily removed with water. Any acid which would cut the grease would be so strong that it would also cut the skin of the person working with it.

(12912) F. P. asks: How is it possible for a wind instrument to be "flatted" or blown out of tune? A. The changing of the tone in pitch by overblowing, as it is called, is common to all wind instruments. It is treated in Barton's "Sound," under the several instruments. We send the book for $3.25 postpaid. With instruments where the lips form the reed whose vibrations produce the tone, the size of the tube and the temperature of the air have an important effect upon the pitch of the tone. On the cornet it is said that the player can force the note a quarter tone flatter or sharper than its normal pitch. Barton, page 449.

(12913) J. M. L. asks: Can you furnish me with a description or give any information pertaining to apparatus for producing nitric acid from atmospheric air, from Bradley and Lovejoy, Birkeland-Eyde? It is mentioned in the SCIENTIFIC AMERICAN of September 6th. A. We have published several papers on the modes of producing nitric acid by the electric arc. You will find them in our SUPPLEMENT Nos. 1640, 1641, 1642, 1643, 1644, a series, also 1667, 1668, 1691, 1692, 1748, 1767, and 1784, price ten cents each. These papers will give you a complete review of the subject.

(12914) H. W. R. asks: I would be glad to know your authority for the statement that the Roentgen rays have the precise wave length of 0.01 micron. A. The authority for the statement of a wave length for Roentgen rays is the reports upon the diffraction and interference measurements of these rays, which have appeared in the scientific periodicals for several years past. If you are a member of the American Physical Society, you will have a file of the Science Abstracts, Section A, in which you will find the abstracts of these papers. We would refer you to the following: June 30th, 1913, vol 16, part 6, Abstract 994, July 28th, 1913, vol. 16, part 7, Abstract 1,153; October 27th, 1913, vol. 16, part 10, Abstract 1,667. We might name others. These are all references to German scientific publications. We give the reference to the Science Abstracts since you are more likely to have that at hand than the original German publication. The results of these investigations are not in complete accord in the wave lengths and could not be expected to be, as you know.

(12915) M. Z. Asks: Kindly let me know through your correspondance column the correct conclusion to the following experiment. The experiment consists of balancing a 50-centimeter stick which is weighed down on one end. The point where it balances is found to be 39.6 centimeters from one side. Then put a 50-gramme weight on the end of the lighter side. The stick now balances at 32.4 centimeters. The 50-gramme weight took up the space of 2 centimeters on the stick. Now A claims that the weight of the weighted stick originally can be found from this to be 218.1 grammes, which he gets by multiplying 50 grams × 31.4 (distance between centre of weight to point of equilibrium) and dividing by (39.6—32.4) or the distance from the first point of equilibrium to the second point of equilibrium. Also that these 218.1 grammes act as if they were concentrated at the point 39.6. B contends that the first moment is not 50×31.4, but that the weight of 32.4 centimeters of stick must with the 50 grammes be considered as the weight tending to produce the moment of rotation. This multiplied by the distance that the resultant of these forces is from the point 32.4 is the moment. Also he contends that A makes the same mistake in the other arm; and the weight to be considered here is not the weight of the whole stick, but of that arm, and is not concentrated at the point 39.6. A. A is quite correct in his solution of the problem of moments, with a weight upon the end of a 50 centimeters bar, which balances at 39.6 centimeters from the light end, and when a 50-gramme weight is added to the light end balances at 32.4 centimeters from the 50-gramme weight. The answer is 218.055 + centimeters, or 218.1 centimeters as A gives it. It is a universal principle that any body acts as if its matter were all at its center of gravity. This weight is 7.2 centimeters from the last balancing point, and the center of gravity of 50 grammes is at 31.4 centimeters from the balancing point. Then 50 times 31.4 equals 7.2 times the weight of the stick and small weight. This is one of the usual experiments in moments given to students in the high school course in physics, and is not considered a difficult experiment for the beginner.

(12916) M. J. G. asks: Kindly inform me the fusing points of the following metals: plumbago, iron, wolfram, tungsten, nickel. What I wish to know are the fusing points by electric currents. A. We give you the melting points of the substances which you name, as given in the Circular of the Bureau of Standards, No. 35. Iron melts at 1,520 deg. Cent. or 2,768 deg. Fahr. Tungsten or wolfram melts at 3,000 deg. Cent. or 5,430 deg. Fahr. Tungsten and wolfram are the same. Nickel melts at 1,452 deg. Cent. or 2,646 deg. Fahr. It makes no difference what source of heat is employed, electricity or a flame, the substance melts at the same temperature. Plumbago or carbon is not a metal, but its melting point is given as 3,600 deg. Cent. or 6,500 deg. Fahr. for a pressure of one atmosphere. This temperature is given by the electric arc, and possibly by some gas flames. The figures we have given vary somewhat from those given in the textbooks, but they may be assumed to be later and from better determinations. We should consider them as having a higher authority.

(12917) A. C. H. F. asks: Could you furnish me with any information concerning the Tralle and Richter scale as applied to hydrometers. I have sought information in several books, but could find no reference as to the method of graduation of these scales, and I would be greatly obliged if you could send me some information on this subject. A. Tralle's hydrometer is an alcoholometer, and gives the percentage by volume of alcohol in a solution of alcohol and water. It is based upon water at 40 deg. Cent. and a density of pure alcohol 0.7939 at 15.5 deg. Cent. The corrections for other temperatures must be obtained from a table. You will find a good article upon hydrometers in the Encyclopedia Britannica, vol. 14. The scale begins from the density of pure water, and indicates 1, 2, 3 per cent, etc., of alcohol by volume mixed with the water.

(12918) R. H. T. asks: How is the wire wound in such even layers on the magnets used in telephone ringers and on the secondaries of induction coils? A. Wire is wound on the bobbins for the coils of magnets, etc., in the same manner as thread is wound on spools. A machine turns the bobbin and a carrier moves the wire along for each turn of the bobbin as far as the thickness of the wire. At the end of the bobbin the machine feed is reversed and the winding is carried along in the opposite direction. So the wire is wound on in perfectly even layers in a manner impossible to be done by hand. It is done with great rapidity.

(12919) S. de J. asks: Will you be kind enough to let me know what the chemical name is of so-called banana oil, used as a vehicle for gilding? A. The chemical name for banana oil is amyl acetate. It is used in perfumery, the manufacture of mineral waters, and syrups, and in the Heftner lamp as a standard of light, as well as in stains and gilding.

(12920) N. S. asks: Have you any information for making a syrup by adding 6 pounds sugar to ½ gallon of water, and either boiling or dissolving the sugar and placing same in a sealed can, using a process in which it will not ferment or turn back to sugar when in such sealed can, and not use any preservative? A. The only way we know to preserve a solution containing sugar is to sterilize it by heat and seal it air tight in a can. The method is the same as is used in canning fruit. If air comes in contact with the solution, germs of fermentation will surely get in and the syrup will be spoiled.

(12921) I. W. asks: Some time since I received one of your books of formulæ, and I find that the very one I want is a bit ambiguous. I wish you would set me straight. The formula I want to use is the one for nickeling, page 481. Am I to understand that there are three separate baths, First, potash and chlorhydric acid; second, sulphate of copper, sulphuric acid; third, cream of tartar, etc.? The formula also fails to state what sized leaves of zinc to use or how to attach them. Must the zinc be chemically pure or will ordinary commercial zinc do? A. There are three baths in the process of nickeling as given in the "Scientific American Cyclopedia," page 480. The first bath is the cleaning bath, to cut off all the grease and rust and leave the articles so that the metal will adhere as firmly as possible. After they are cleaned they are attached to strips of zinc. Common sheet zinc is employed, nor is a large piece required. A piece 2 inches by 4 inches will answer for a large sized article. Experience will enable you to decide that. In the second bath, as given in the book, an electrical action takes place and the article is plated with copper. The nickel will not adhere well to iron, but copper will adhere well to iron. When the pieces are well coppered, they are red in color, and the third bath of nickel sulphate is used for the final coating with nickel. The after burnishing and polishing is the same as in all work of that kind. We hope this is clear and plain.

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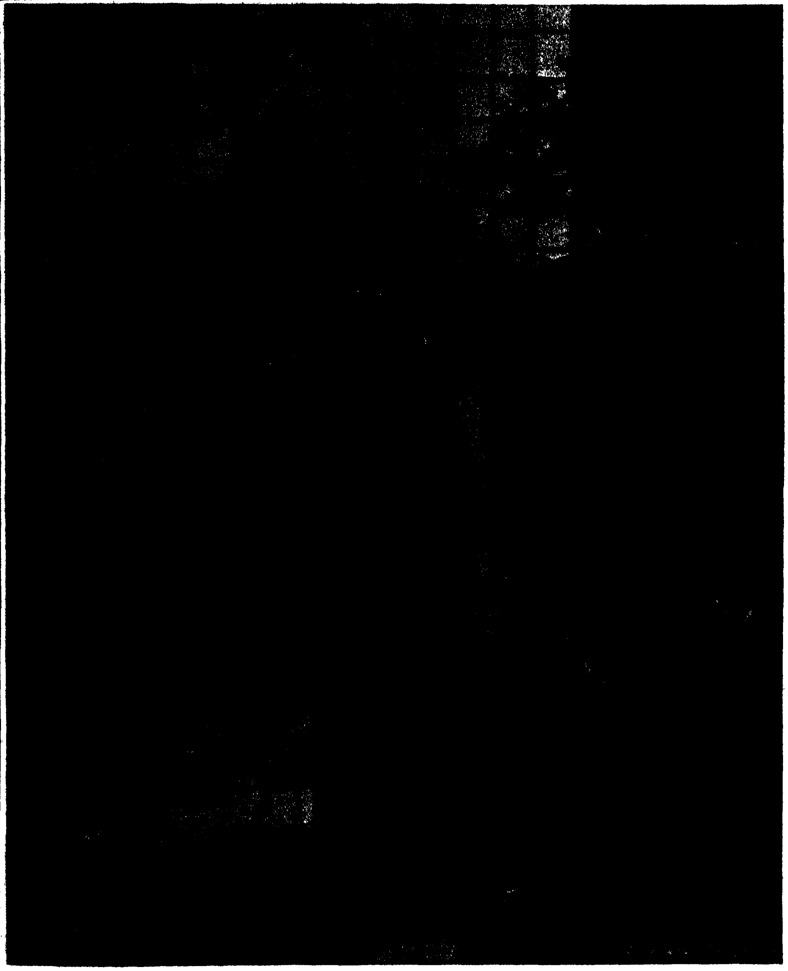

WRESTLING WITH THE GYROSCOPE IN CHINA

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Legal Triumph of the Wrights

THE decision which has been handed down by the Circuit Court of Appeals in the infringement suit brought by the Wright Company settles once and for all, in this country at least, the question: Who invented the flying machine? To be sure, there was never any doubt in the popular mind. Practical achievement counts for so much and paper discussion for so little, that the inventor who rises above the mere theoretical presentation of his ideas is inevitably glorified. The decision of the Circuit Court of Appeals stamps the popular verdict with approval and recognizes Orville and Wilbur Wright as the inventors of the man-carrying, motor-driven aeroplane.

The decision is historically and psychologically interesting because it proves once more how small is the gap between success and failure in invention. Not a single one of the elements in the original Wright machine was new. Chanute had first used the trussed frame with success. Maxim had first placed the horizontal rudder forward. The method of controlling the lateral balance by changing the impact angles of the wings had been proposed over and over again. The vertical rudder was an obvious mechanical expedient for directing the machine in a horizontal plane. Ader and others had proposed or used sled runners. Not a single element in the machine was absolutely novel; yet as a whole it was the most novel mechanism that could be imagined. Not until the Wright brothers appeared had anyone flown successfully in a motor-driven flying machine. Why? Simply because they were the first to recognize the necessity of using the vertical rudder in connection with the wing-warping mechanism in order to prevent the skidding of the aeroplane in straight-away flight—a skidding produced by the increase of resistance on one side and a decrease on the other side in warping the wings. Slight as that discovery seems, it made success possible where only failure had been encountered before.

This is the history of many other inventions. Morse, Bell, Fulton and the rest, all of them seized the abandoned devices of their predecessors and combined them into commercial operative inventions. To the world at large it seems but a little thing to step in this manner from failure to success; yet only a master mind succeeds in grasping the true relation of a dozen mechanical devices, hitherto uncombined, and in uniting them in some brilliant invention for which the world is immeasurably richer.

The decision in the Wright case ought to lay low the idea that the invention of a light gasoline motor made the flying machine possible. If that were really true, the man-carrying aeroplane should have appeared twenty years ago. To be sure, the motors of that period were not light; but on the other hand, the long flights that have been made in recent years with two, three and even five passengers, proved conclusively that lightness of motor was not the only consideration. The Wright brothers succeeded, not because they built a light motor with their own hands, but because they had solved a problem in aerodynamics which had baffled the best scientific thought of centuries.

Tire Failures and Railway Speed

AS the result of its investigation of a derailment which occurred last year at Stockwell, Indiana, the Interstate Commerce Commission came to the conclusion that the accident was caused by a broken tire on one of the car wheels.

A most illuminating and interesting branch of the Commission's investigation of accidents is that which is carried on by the Bureau of Standards, to which sections of broken rails, broken tires or other informing fragments from railroad wrecks are sent, for thorough microscopical, chemical and physical analysis, and the deduction of the proper lesson therefrom. This was done in the case of the broken tire above mentioned, with the result that the Bureau found the breakage resulted from heat cracks which had formed in the tread of the tire.

Now the high temperatures to which car tires are subjected are due to brake action, the heating effects of which are considerably aggravated by the high speed under which modern express traffic is carried on. The heating of the tires depends upon the pressure applied by the brake, the speed of rotation of the wheels, and the time during which the brake is applied. Evidently the greatest heating effect will be produced if the brakes are applied continuously at maximum pressure when the train is running at top speed.

How greatly the heating of the tires is aggravated by high rates of speed is evident if we consider the case of two trains, one of which is running at 80 miles an hour and the other at 60 miles an hour. In this case, since the momentum of the train varies as the square of its speed, the energy transformed into heat at the brake shoes will be twice as great at 80 miles an hour as it will be at 60 miles an hour. If the brakes are applied at full pressure at 80 miles an hour, the train will run over 1,500 feet before the speed has been reduced to 50 miles an hour, that is to say, the train would run for 1,500 feet at an average speed of nearly 65 miles an hour with the brakeshoes on under full pressure.

Hence, during a small fraction of a minute, the greater part of the energy of the moving train is converted into heat on the abutting surfaces of the brakeshoes and the tires. The outer inch or so of the tire is very rapidly raised to a high temperature, and it reaches that temperature quicker than the heat can be conducted to the inner portion of the tire. Now we must remember that the tire was originally fastened to the body of the wheel purely by shrinkage effects, and that when the hot tire cooled, it was thrown into a condition of heavy tensile stress throughout its whole thickness. Hence the theory has been advanced that when the sudden heating of the outer layers of the tire under the frictional contact of the brake takes place, the outer metal of the tire expands and the inner metal has to carry, for the time being, the whole of the heavy initial stresses of shrinkage. A condition may be reached in which the shrinkage tensional stresses are too great for the unheated section of the tire, and in this case fractures, known as thermal cracks, may occur. These fractures may be difficult to detect; and hence there is a call, particularly on high-speed trains, for most careful and systematic inspection.

A Comparison of British and American Battleships

WE publish on our correspondence page a letter in which the writer draws a comparison between the British 25-knot battleships of the "Queen Elizabeth" class and our own latest battleships. He claims that, because the armor of the British ship is thicker (though there is some doubt as to this) the principal gun heavier, and the speed greater, therefore the "Queen Elizabeth" must be a more effective ship than our "Nevada" or "Pennsylvania."

Now the displacement of the "Queen Elizabeth" and the "Nevada" is given as about the same. But this means that when the English ship is loaded with the same proportion of her total amount of ammunition, fuel, stores, etc., as the "Nevada," she will be of considerably greater displacement; for the English displacement, as given in published statements, represents the weight of the ship, not when she is in fighting condition, as it does in the case of the ships of our Navy, but when she has only a limited portion of her fuel and stores aboard.

Now as to the superiority. The English 15-inch gun is of one inch larger caliber than the 14 inch gun carried by the "Nevada." But our correspondent does not know, probably, that the muzzle velocity of the English gun is considerably lower than that of our 14 inch gun; that the energy is not very much greater; and that the penetration at the probable battle range of ten thousand yards is about the same, although the bursting charge of the 15 inch gun, of course, is considerably larger. Furthermore, he omits to state that the "Nevada" carries ten 14-inch guns as against eight 15-inch guns carried by the "Queen Elizabeth." Also, there is reason to believe that the fuel supply of the "Nevada" is greater than that of the "Queen Elizabeth," that is to say, that she could keep the sea longer without calling up the colliers or returning to a coaling station. And, yet again, any one who is familiar, even in a general way, with naval design, knows that the extra weight put into machinery to secure 25 knots as against 21 knots is so great that some other important military element in the ship, such, for instance, as the internal subdivision as a defense against torpedo attack, which in our ships is most elaborately worked out, and is probably more complete than it is in the British ships, must have been sacrificed in favor of boilers and engines.

It is an accepted principle of the tactics of a line-of-battle engagement, that the fleet must be kept together as one unit, the speed of the faster ships being accommodated to that of the slower, so that the latter be not left behind to be cut off and sunk in detail by the enemy. The average speed of the British fleet, like that of our own, is about 21 knots; or, say, 18 to 20 knots in an actual engagement. If the British 25-knot "Elizabeths" are to lie in line with the rest of the fleet, they must not use their highest speed, but must carry within their hulls hundreds of tons of motive power, which they may never be called upon to use throughout the whole engagement.

The British naval staff, in designing these five remarkable ships, has, no doubt, assigned to them some definite work in the strategy and tactics of the various war plans which it is the duty of the staff to formulate and work out. In the absence of knowledge of what these plans are, the ships look to be an odd size—too fast for the first line of battle; too slow for the [illegible]-knot battle-cruiser class.

A New Use for Patents

WHEN the distinguished Dr. Ehrlich, the discoverer of salvarsan, better known as "606," was asked by a German medical association why he had patented his remedy, he replied that he wished to control its manufacture, not in order to make money, but in order to protect the public by guaranteeing its quality. Thus he showed that a professional man may use a patent for a purpose which probably never entered the heads of those who framed the patent laws of civilized countries.

The medical profession, as Mr. Burton Hendricks points out in his article, "The New Medical Ethics," published in a recent number of *McClure's Magazine*, is rapidly abandoning the foolish principle of not patenting its discoveries, for the very reason given by Prof. Ehrlich. It is better to run the risk of being accused of commercialism than of permitting dishonest manufacturers to make a remedy as they see fit. The physician himself cannot guarantee these various products. Hence the need of some method which will insure the public against fraud, and hence the value of patents.

This opens up the question why the patent laws should not be extended to cover discoveries in applied science which cannot now be legally protected. Burbank gives the world a new fruit, a fruit more nutritious, more reproductive, more palatable than any that mankind has known before. It costs him a fortune to experiment before he finally develops it to marketable perfection. No patent laws protect him from the appropriation of his discovery. So, too, the application of Mendelian principles to plant and animal breeding where they involve what may be regarded as the equivalent of invention, should certainly be accorded some protection. Why was not the discovery of Hellrigel that the bacteria nodules on the roots of leguminous plants reduced the nitrogen of the atmosphere in the form of an absorbable nitrogenous fertilizer patentable? Its later improvement has enriched the world by millions. And so we could enumerate a hundred practical scientific discoveries which have enriched the world, but which are now left to the tender mercies of quacks and frauds.

Recovery of Lost Handwriting by Photography

FADED handwriting is perplexing to antiquarians and lawyers and its recovery may be of importance. A recent method depends on the fact that most inks, even ancient inks, are acid in reaction. Nitrated silver chloride paper is kept in contact with the faded text twelve hours or more and then exposed to full light. The action of the acid in the ink on the silver chloride brings about a reaction which is completed by sunlight—reduction to metallic silver which now shows in metallic luster on a dark ground. It is impossible to make this image permanent, but it is legible for a short time. This writing may be made more readily visible by submitting the paper, after exposure, to the fumes of burning phosphorus in a closed box. Another method of developing this image after contact with the faded manuscript is to pour mercury on it from a height of about a foot and then immerse the paper in dilute ammonia. Or the exposed paper may be placed in bright sunlight for fifteen minutes and then pressed against a dry plate which is afterward developed with dilute rodinal. Dampening the faded document permits the aid of a weak solution of hydrogen peroxide.

[illegible]

[illegible] of Mechanical Stoking of Locomotives.—It [illegible] that when a satisfactory mechanical stoker [illegible] large locomotives was developed, it would have [illegible] application. We are informed by one large [illegible] stoker company in this country that it has [illegible] present time over 400 stokers in regular operation [illegible] locomotives in the United States, and that 200 of [illegible] in use on the Baltimore & Ohio Railroad.

[illegible] Blast in Aqueduct Tunnel.—The blast which re[illegible] the last barrier in the Catskill aqueduct tunnel [illegible] by the Mayor of this city on January 11th. [illegible] extends uninterruptedly from the Ashokan [illegible] in the Catskills to the terminal shaft in Flat[illegible] now remains to be lined throughout with [illegible] and when the control apparatus has been [illegible] the aqueduct will be ready for use.

[illegible] From Automobiles in New York City.—The [illegible] of the National Highways Protection Society [illegible] that 25 persons were killed by automobiles in New York city in December. This brings up the total for the year 1913 to 302 fatalities in this city, of which [illegible] 149 were children. In the State of New York, [illegible] of the city, the totals for the year are: auto[illegible], 150; trolleys, 79; wagons, 32.

[illegible] Pelton Wheel in Switzerland.—The hydraulic [illegible] situated on the Lontsch River in Switzerland is [illegible] what is claimed to be the largest Pelton wheel in Europe, the wheel being of 15,000 horse-power capacity. In the same station there are already six Pelton wheels of 6,500 horse-power, so that the addition of the latest wheel brings the output of the Lontsch plant up to 54,000 horse-power and makes it one of the largest plants in Switzerland.

Completion of Mt. Royal Tunnel, Montreal.—On December 10th, 1913, after fifteen months of tunneling through 3 1/10 miles of rock, the railroad tunnel under Mt. Royal, Montreal, was completed. This establishes a record for tunnel building through such material in America. The work was done by the Canadian Northern Railway Company. The excavation of Swiss tunnels has been done in less time, but generally the rock encountered was not so hard as that at Mt. Royal. The present inside measurements of the tunnel are 8 x 12 feet. When the work is completed it will be enlarged to 22 x 30 feet to accommodate two tracks.

Lofty Cantilever Bridge.—A lofty bridge of the cantilever type has recently been completed for the National Railways of Mexico over the Rio Chico on a new line between Durando and Llano Grande. It was planned at first to build a steel viaduct over the ravine, but later the engineers decided to construct a single track cantilever bridge. This structure has anchor arms, 105 feet long, and cantilever arms, each 135 feet in length, carrying a suspended span of 120 feet. The total length of the bridge between back walls is 701 feet 6 inches. The base of the rail is 244 feet above the bottom of the ravine.

Ocean Voyage of Submarines.—The four submarines which left Cuba on December 7th, proceeded under their own power to Cristobal at the Atlantic end of the canal. This trip (700 miles in the open sea) marks an advance in the navigation of submarines. The sea was rough under the influence of strong trade winds during the entire journey, but the boats found no difficulty in maintaining their speed and position for the five days consumed on the trip. The officers and men at the conclusion of the voyage were in as good, if not better, condition than at the outset. The submarines arrived with their fuel bunkers *half* full.

Gatun Lake Reaches Its Full Height.—On December 27th last the elevation of Gatun Lake was 84.76 feet above sea level, which means that it was practically at its normal height. On December 29th one gate of the Gatun spillway was left open throughout the day, and the outflow lowered the surface of the lake to elevation 84 above sea level, at which it will be held until the raising of a low spot at Cano Saddle is completed, and it becomes possible for the lake to rise to its maximum height. All the fourteen gates of the spillway were raised and lowered smoothly, and the tests were regarded as thoroughly satisfactory.

Sanitary Engineering at Harvard University.—Four new courses are offered by the Department of Sanitary Engineering of Harvard University. One will deal with the study, preparation and interpretation of vital, social and sanitary statistics, with special emphasis laid on their application to public health. Another deals with the principle and practice of sanitation and hygiene as applied to the farm, at the summer resorts, in camps, etc. The third course is for students who have never studied bacteriology and who wish to gain a general understanding of the relation of bacteria to the processes of nature, to chemistry, to sanitary science, and to health. A fourth course for specializing in government and business administration deals with the principles of [illegible] and sanitary engineering, with special reference to their administration in cities.

Science

A Uniform System of Shorthand in Germany.—For some time a movement, under government auspices, has been on foot in Germany to unify the various systems of stenography now in use in that country. A committee of 23 experts is now examining proposals submitted by representatives of 40 different systems.

The Antarctic Expedition under J. F. Stackhouse, which is to sail from England next summer, proposes to explore the little-known region between Graham Land and King Edward VII. Land, beginning at the former, and working along the coast, so far as ice conditions may permit. The expedition has opened headquarters in London, at Sardinia House, Kingsway, W. C., and is soliciting contributions.

The Classification of Stellar Spectra, as carried on at Harvard University, was described by Prof. E. C. Pickering at a recent meeting of the Royal Astronomical Society. The task in progress is a vast one, as it will entail the classification of perhaps 200,000 stars. However, about 500 spectra a month are now classified by Miss Cannon and her staff of assistants. Prof. Pickering also described the work of investigating some variable stars of remarkably short period; one of them doubles its light in seven minutes.

A Memorial to Baron Toll, the Russian explorer who, with six companions, was lost somewhere in or near the New Siberian Islands in 1903, is to be erected on the west coast of Kotelnyi Island, from which he embarked on the last known stage of his journey, viz., to Bennett Island. It consists of a tablet bearing a relief portrait of the explorer, with suitable inscription. General interest in Toll has recently been revived by the discovery on Bennett Island, by Lieut. Wilkitsky (or Vilkitskii), of the lost explorer's diaries and collections.

The Pellagra Investigation Committee, of Great Britain, has sent Dr. Louis Sambon to America to study this disease in the West Indies and the United States, with the aid of funds furnished by Mr. N. S. Wellcome and several West Indian governments. Dr. Sambon, who has previously investigated the disease in Italy, does not accept the common belief that pellagra is due to the consumption of damaged maize, but considers it an infection conveyed by an insect, viz., a Simulium, or sand-fly.

Land Reclamation in Holland, a task that has been prosecuted steadily for centuries with such indefatigable energy (the Hollanders boast somewhat irreverently that "God made the world, but the Dutch made Holland"), is still going on as actively as ever. From 20,000 to 25,000 acres of land are reclaimed every year. It is said, however, that more than 250,000 acres of the best soil is still under water, not including the great area under the Zuider Zee, the reclamation of which is a perennial topic of discussion.

The Drought of 1913 in the eastern and central United States was one of the most severe on record. In New York State, according to the *Monthly Weather Review*, the droughty summer was the most severe experienced in at least forty years. It was remarkable both for its duration and for the time of its occurrence, as it began to retard vegetation quite generally by the second week of June and, in spite of occasional rains, became gradually worse until the heavy rains of August 22nd–23rd. The failure of pastures and the drying up of wells and streams never before known to fail were reported from many parts of the State.

A New Idea in Weather Predictions is brought forward by Freiherr von Myrbach in the *Meteorologische Zeitschrift*. Every meteorologist knows that the coming weather cannot always be forecast with an equal degree of confidence; there are times when the current weather chart indicates the conditions that will prevail over a particular region twenty-four hours later with almost certainty, while, on the other extreme, there are weather charts from which prediction is little better than guesswork. The writer suggests that the public could use the weather forecasts more intelligently if the reliability of the latter were in some way indicated by the forecaster, and he suggests a numerical notation for this purpose.

The Crocker Land Expedition, commanded by Donald B. MacMillan, is now in winter quarters at Etah, Greenland, having been prevented by unfavorable ice conditions from crossing Smith Sound to Ellesmere Land, where it had been planned to establish the base. The vessel in which the expedition sailed from New York on July 2, the "Diana," was stranded on the rocks off Barge Point, Labrador, July 17. As she proved to be unfit for further service, the steam sealer "Erik" was chartered at St. John's to take her place, and a new start was made for the North on August 5. Along the Greenland Coast a number of dogs and Eskimo drivers were secured for the expedition. After disembarking the explorers, with their stores and equipment, at Etah, the "Erik" returned to St. Johns. An exploration of the Greenland ice cap is on the programme for the coming winter and spring.

Inventions

Sign-writing Made Easy.—With a view to simplifying and facilitating the preparation of signs and show cards by storekeepers and others, Sidney Hacker of Mt. Vernon, N. Y., in a patent, No. 1,063,969, provides an outline figure or figures suitably formed for manipulation by an unskilled person to aid one in quickly outlining letters or numerals.

A Reversible Moving Picture Film.—Charles E. Dresler and Isaac W. Ullman of New York city have secured patent No. 1,073,411 for a moving picture film which has one series of pictures running lengthwise of it and another series of pictures also running lengthwise of the film, but in the reverse direction, with the pictures of the two series upside down relatively to each other.

An Anti-suction Shuttle.—A patent has been granted to Edwin H Ford of New Bedford, Mass , No 1,071,039, for a hand-threading anti-suction shuttle in which a downwardly inclined passage extends through the wall of the filling runway to the shuttle eye and acts as a vent to avoid the possibility of threading the shuttle by suction.

A Neck-tie that Can be Adjusted.—A neck-tie that can be lengthened or shortened is presented in a patent, No. 1,073,875, to John Calvin Stanford of Atlanta, Ga. The tie has a strip of rigid material secured by a single transverse line of stitching between the ends of the tie so that the material of the tie may be folded over the strip in different directions to effect different adjustments in the length of the tie.

An Electrically Heated Glove.—In patent No. 1,073,926, to Anton Polak of Paris, France, is shown a glove which for the purpose of electrical warming has insulated flexible conductors which serve as heating bodies and are arranged loose alongside of each other and fastened at only a few points to the glove so that their freedom of movement is preserved as far as possible and the extensibility of the glove is substantially undiminished.

An Ozonizing Apparatus.—A patent has been issued to the administrators of Edward Charles Spurge of Niagara Falls, for an ozonizer, whose casing is hollow and constitutes one of the electrodes and is combined with a unitary structure consisting of two dielectrics and an electrode between them, with the unitary structure clamped between the casing parts to provide gaps on each side of the unitary structure.

Applying Wall Paper by Machine.—Patent No. 1,071,812 has issued to Christian J Siebenhaar of Oramel, N. Y., for a wall papering machine in which an extensible frame is provided with means for extending and collapsing it and paper and paste applying mechanism are supplied on a holder, together with devices carried by the extensible frame for pasting the paper on a wall or ceiling.

Some Hydrocarbon Burner Patents.—A series of seven patents, Nos. 1,070,603 to 1,070,609, both inclusive, have been issued upon the invention of Walter E Huenefeld of Cincinnati, Ohio, for improvements in hydrocarbon burners having wick tubes and for laminated shells forming combustion chambers. Patents Nos. 1,070,608 and 1,070,609 have been issued directly to Mr Huenefeld, while the other five are to the Huenefeld Company of Cincinnati as assignee.

An Electrically Operated Safety Razor.—Sampson W. Moon of Chicago, Ill., has patented, No. 1,072,634, an electric safety razor in which the razor head and blade are actuated or vibrated from side to side by electricity, which may be derived from the ordinary lamp socket. The vibrations are lengthwise of the blade so that as the razor is drawn over the face during shaving, the frame and blade are moved rapidly sidewise, giving a saw effect and aiding materially in the cutting of the beard.

A Novel Liquid Meter.—The Leinert liquid meter is an automatic measurer for water, petroleum, sugar juice and other liquids, measurements being made by weight and not by volume, so that temperature does not enter in. It consists of a pair of equal-sized tanks so arranged that when one is filled up to standard level it automatically shifts the feed over to the second tank and is then emptied by siphon recording at each time of filling and emptying. Being actuated by weight of liquid, it is not subject to the sudden inaccuracies of volume meters, and has scarcely any wearing parts. It can also be quickly cleaned and sterilized.

Prize Offered for Improved Horseshoe Design.—It is worthy of note, as probably affecting the roads over which they roll, that the British Roads Improvement Association has offered a prize of £100 for a new or improved type of horseshoe that will provide horses with a satisfactory foothold upon the modern smooth pavements and minimize the damage caused to such surfaces by existing types of shoes. The prize-winning type is to be evolved from open competition. Copies of the rules covering the contest may be obtained by addressing Mr. Wallace E. Riche, secretary of the R. I. A., whose office is at 15 Dartmouth Street, Westminster, London, S. W. There is no entrance fee.

Cleaning Silverware

By L. V. Redman

THE discovery and recent perfecting of electric silver cleaners mark a distinct advance in the art of silver polishing

Silver polishes and cleaners have consisted until very recently of materials which dissolve off the tarnish or cut it off by rubbing with fine powders The black oxide or sulphide which forms as tarnish upon the surface of polished silver appears at first as a film so thin that it displays beautiful iridescent colors of purple and blue; the thickening of the film produces the black oxide color. Solvent polishes are composed of chemicals such as ammonia and cyanide of potash. These chemicals dissolve off the black coating and leave the silver a beautiful satin finish on the surface. The cyanide polishes are very poisonous and should be used only with the greatest caution.

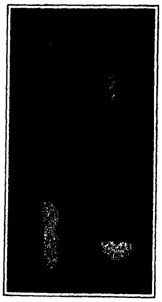
Abrasive polishes are composed of very fine powders and are designed to cut away the tarnish The powders are very hard materials, such as, for example, tripoli, rouge, double floated silica, volcanic ash, kieselguhr, fuller's earth and pumice Each particle as it passes over the surface of the silver cuts off a small part of the tarnish coat, the scratch being too small to be seen by the eye without the aid of the microscope. This method of cleaning silver is very wasteful, as it not only destroys the tarnish, but also destroys or wears away the silver. However, it is the only method which will give to silver that excellent, burnished shield effect, which at times is so much to be desired.

New electric silver polishes are being introduced to the public They are designed to take advantage of the electric current which exists between two metals, when these metals are in contact with each other in water The electric current, which is produced when two metals are in contact in water, is much stronger if an electrolyte like washing or baking soda or common salt be added to the water. The potential is further increased if the water be brought to boiling. Early attempts to make these polishes a commercial possibility were unsuccessful, for the metal used was tin. The water and soda were put in a tin pan and the liquid was brought to boiling. The silver articles to be cleaned were placed in the pan, immersed in the boiling water and in contact with the tin dish. When the pan is new the silver is cleaned rapidly, but the tin soon dies or becomes passive, that is, covered with an insoluble film of tin oxide, which will not conduct the electric current. Once the tin pan becomes passive, it is thrown away and a new one takes its place The fault never lies with the powder. The powder is invariably soda or soda mixed with a little common table salt.

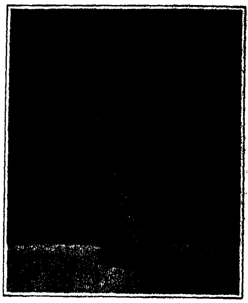
With the introduction of aluminium kitchen utensils another method was adopted for cleaning the silver. The aluminium dishes were used in place of the tin. The voltage is much higher between aluminium and silver; the cleaning of the silver is the matter of a moment if a spoonful of soda be added to the boiling water. The pan will clean the silver if the silver is left in cold water in the pan over night However, this method of using aluminium utensils is not to be recommended, as the vessels are soon blackened on the inside and the aluminium ware is dissolved away by the soda and destroyed.

Aluminium dishes have been made and patented, for the special purpose of serving as silver cleaners. These boxes or pans are fitted at the bottom with rods of zinc which serve as an electric contact between the aluminium and the silver articles. The pans or boxes work fairly satisfactory, and because the zinc rods serve as conductors, they do not go passive or dead as the tin is inclined to do.

Another form of electric polish has been introduced into the market very recently which for cheapness and efficiency is at present unequaled. The powder is put in small packages and is accompanied by a sheet of metal which is an alloy of aluminium and other metals higher in the electric series. All that is needed is a vessel of granite, iron or tin in which water may be boiled. The powder is put into the boiling water and the sheet of metal is thrown in among the silver articles which are being cleaned. The only precaution necessary is to take care that the piece of metal is in contact with the silver. The cleaning is done in a moment and several pieces of silver may be cleaned at the same time. As soon as the cleaning is accomplished the metal should be taken out and washed in hot water and dried, if the best service is to be obtained from it. As these silver cleaners are composed only of washing soda and salt, there is nothing in them injurious to health. The silver after cleaning should be washed in pure hot water and dried, otherwise it may have a slightly yellow color and taste bitter or brassy. These effects are due to the soda which remains upon the surface of the silver and tarnishes it yellow. These electric polishes do not dissolve the tarnish of silver as ammonia and cyanides do. Nor do they wear off the coating of black as the rubbing powders do. The blackened silver is actually reduced to bright metallic silver by this method and is replated upon the silver article. Thus the silver surface is preserved and the life of the silverware prolonged indefinitely by this treatment. Laboratory tests have shown that silver vessels placed in sulphur or sulphides until the silver is blackened and then cleaned by this electrolytic method, do not lose enough silver in one hundred treatments to be detected with a scale which weighs accurately to one two hundred and fifty thousandths of an ounce. The rapidity of the cleaning, the simplicity and the cheapness of the method, and the saving on the silver, should recommend the method to every one interested in silver cleaning.



Tarnished silver partly cleaned by electrolytic process.



Cleaning a knife by immersing it with an aluminium rod in a hot soda and salt solution.

An Electrical Automobile [illegible] System

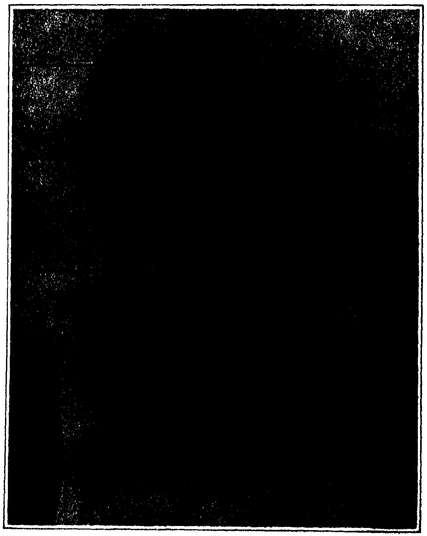
By [illegible] Babcock, M.E.

THERE appeared at the recent [illegible] Grand Central Palace in New York a [illegible] type of electric automobile transmission, [illegible] performing the functions now performed by the [illegible] day type of electric engine starting system. [illegible] apparatus eliminates the usual [illegible] master clutch between the engine [illegible] remainder of the propelling [illegible] well as change gear set and [illegible] wheel. Thus it substitutes for [illegible] gearset and flywheel and [illegible] and their various controls, a [illegible] with a single moving part [illegible] trol lever. With that single [illegible] it is possible to obtain seven [illegible] ratio between the speed of [illegible] crankshaft and that of the [illegible]

In its simplest aspect, the new [illegible] consists of a compact generator, [illegible] wound motor unit and an 18-volt [illegible] pere hour storage battery. The [illegible] can be eliminated, for no reliance is [illegible] upon it for the operation of the transmission; it serves merely as a source [illegible] rent for starting the engine and for carrying the lamp load as in the ordinary electric lighting and engine starting system.

The generator portion of the system has its field mounted in place of the [illegible] engine flywheel which thus is eliminated. The armature is keyed fast to the propeller shaft. The motor unit is mounted just back of the generator with its armature also [illegible] to the propeller shaft, but with its field securely anchored to the chassis frame. The whole, generator [illegible] motor, is completely inclosed in a tight aluminum housing, as is shown by the accompanying illustration, and therefore is thoroughly protected from the insidious action of dirt and moisture and from accidental injury.

The principle of operation can be described briefly as magnetic drag. When the engine is started, the rotating field of the generator exerts a certain drag upon the armature which thus is rotated, carrying with it the propeller shaft and moving the car. The slippage between the field and the armature of the generator is controlled by the simple expedient of varying the strength of the field partly with the aid of resistance, and it is this slippage that affords the change in gear ratio between the engine and the driving axles. Obviously, the slippage results in the generation of a certain amount of current which ordinarily would have to be absorbed by resistance and thus be lost in heat. It is here, however, that the motor unit assumes the place of importance it occupies in the system. Instead of being lost in resistance, the generated current is passed to the motor, which thus becomes a source of energy and assists in propelling the car.



This electrical transmission performs all the functions of an automobile engine starter and eliminates the clutch, changes gear set and flywheel.

When the car is first started—with the control lever in the first speed position—the slippage is at its maximum and hence the maximum amount of current is passed to the motor, the result being that we have a comparatively high torque for starting when it is most needed. As the speeds are "notched up," the motor gradually is cut out of the circuit until at what in the average automobile corresponds to high gear, the motor is virtually dead.

With regard to the amount of slippage that takes place at what may be termed the "high gear" position—and hence the efficiency of the mechanism—it is stated that with the engine crank-shaft rotating at 1,000 revolutions a minute, the speed of the armature will be approximately 960 revolutions a minute. In other words, with the car running on a level road, there is a loss of about 40 revolutions a minute between field and armature. On steep hills, or in sand or mud the slippage may be expected to increase slightly. A fair average would place the efficiency at from 93 to 96 per cent.

As there is no mechanical connection between the engine and the propeller shaft it is evident that an extreme degree of flexibility in the drive must result; it is impossible for engine impulses to be transmitted—a car will run as smoothly, in fact, with three of its four cylinders working as it will with them all firing—

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Wireless Time

An Interesting Experiment Made at Beloit College

By Dr. E. A. Fath, Director of Smith Observatory

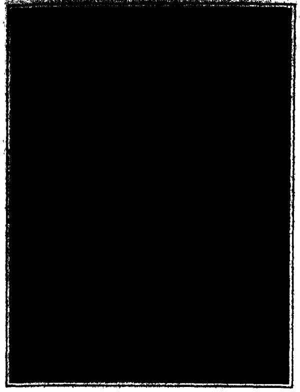

Fig. 1.—The sidereal clock. Note the massive stone pier to which it is attached. Rigidity of support aids in having a clock run uniformly.

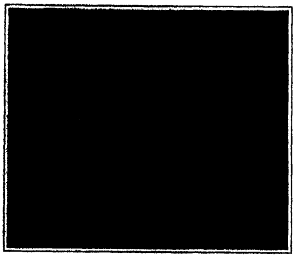

Fig. 2.—The chronograph, for use in recording the instant of a transit.

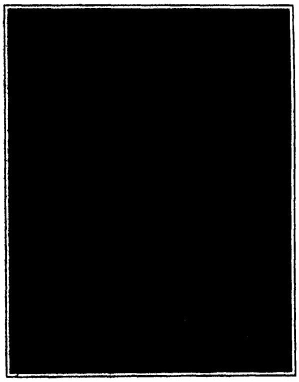

Fig. 4.—The transit instrument. The observer has the chronograph key in his hand to record the time of star transits.

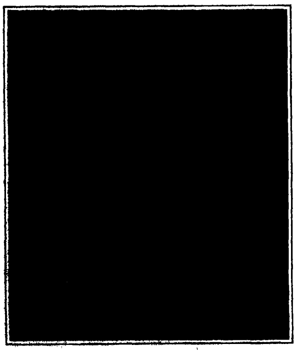

Fig. 5.—The wireless transmitting equipment. The last switch is being thrown before time signals are sent out.

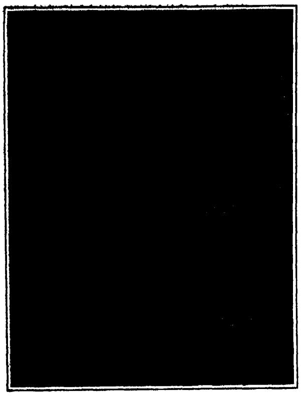

Fig. 3.—The standard time clock. The observer is ready to cut out the required beat during the sending of the signals.

THE determination of time is one of the very practical aspects of astronomy and many observatories are engaged in it to some extent. Up to the present time, it has always been necessary to have direct wire communication with an observatory in order to obtain essentially correct time, but with recent developments in wireless telegraphy the metallic circuit is no longer needed. It is therefore possible for anyone equipped with suitable receiving apparatus to obtain correct time provided some observatory can deliver the proper signals to a wireless transmitting station. Co-operation of this kind has been established in France between the Paris Observatory and the Eiffel Tower radio station, and similar combinations are reported at other points in Europe. So far as known, however, the service to be described in this article is the first serious attempt in this country to send out regular time signals by means of electric waves. The plan originated with Dr. C. A. Culver, Professor of Physics in Beloit College. After he and the writer had carefully gone over the situation and tried out various schemes, the present plan of procedure was adopted. It is the purpose of this article to describe briefly the methods employed.

There are in the sky some hundreds of stars whose positions have been very accurately determined by observations extending over many years. Owing to the rotation of the earth on its axis, stars cross the sky during the night just as the sun does in the daytime. Since the position of these selected stars has been so carefully determined, it is possible to tell with an accuracy of about one one-hundredth of a second when any one of them should cross the meridian, or north-and-south line, of any point whose longitude is known.

In order to utilize these stars a telescope, usually called a "transit instrument" (Fig. 4) is set up so that, as nearly as possible, its line of sight sweeps along a true north-and-south line in the sky. In order that this telescope may be as stable as possible it is placed upon a heavy pier of brick and stone which is built up from a level five feet below the ground level. At the bottom this pier measures 5 by 6 feet and tapers upward to a capstone 2 feet 8 inches square. When this telescope is set for a certain star, the latter, at the proper time, can be seen to come in at one side of the field of view, gradually cross it and finally disappear on the other side. In the field of view, which is faintly illuminated, there can be seen a series of spider threads arranged as shown in Fig. 6. The middle thread is placed as nearly as possible in the center of the field, and, if the instrument is in absolute adjustment, the star crosses the meridian in the sky at the same time it crosses the middle thread. Knowing the exact position of the star, we therefore know the time of transit.

It then becomes necessary to record this instant. This is accomplished by an instrument called a chronograph (Fig. 2). It consists essentially of a rotating cylinder carrying a sheet of paper and a pen which traces a line on the paper. The astronomical clock (Fig. 1) of the observatory is electrically connected with the pen and causes it to break the continuity of the line at each beat (Fig. 7). By means of a telegraph key the observer at the telescope can cause a similar break whenever the star crosses a spider thread. After identifying the various minutes and seconds on the paper it is possible to determine to about one one-hundredth of a second when the observer made the additional break. This time, however, is the clock time. If the record on the chronograph sheet shows the same time as the instant when the star should be on the meridian then the clock is correct, while if not, the difference is the amount the clock is in error.

The actual scheme of observation, however, is not quite so simple as that outlined above. The telescope may not be precisely in the meridian, one end of the horizontal axis of the telescope may be a very little higher than the other, the line of sight may not be exactly at right angles to the axis, the observer may not press his key with sufficient accuracy, etc.* Accordingly, it is necessary to determine whether any of these sources of error exist, and, if so, how much they affect the result. It is therefore customary to observe the transit of a star over a number of the spider threads and also to use from 6 to 10 different stars. Then, by averaging the results, it is possible for a good observer with first-class instruments to determine the error of his astronomical clock to about one one-hundredth of a second.

The time thus obtained is "star" or sidereal time, and the astronomical clock which keeps this time is called a sidereal clock (Fig. 1). Such a clock is always the best in the observatory for it must be depended upon to run with great accuracy during periods of cloudy weather when it is impossible to check it by means of the stars. The highest grade clocks of this kind can be depended upon to one tenth of a second per week. Some have been known to do even better than this.

The average man, however, is not interested in sidereal time, since it is not of direct value to him. What he wants is solar time, and, more particularly, standard time which is now used in almost all civilized countries It is therefore necessary to change sidereal time into standard time. This is easily accomplished by means of suitable tables and a moment's calculation. Then another clock, the standard time clock (Fig. 3) is set to show this time. This clock need be only a fair time keeper, for it can be compared with the sidereal clock and any error easily corrected. At this observatory it is our policy to make such a comparison and set the standard time clock correct to about one tenth of a second just before the daily time signals are sent out.

By means of a simple device, the standard time clock is made to operate a telegraph relay in such a way that each time the clock beats, a circuit is closed, and thus the relay ticks with the clock. This relay, which appears at the right in Fig. 3, is connected by wire to a similar instrument which controls the wireless apparatus of the department of physics in another building.

The accompanying engraving (Fig. 5) shows the radio-transmitting equipment. *A* is a high tension transformer. This is supplied with alternating current at 110 volts and having a frequency of 60 cycles The transformer changes the voltage to about 30,000 and charges the high tension condenser, *B*, seen at the right. This condenser discharges through the usual spark gap and oscillation transformer *C*. The last device changes the frequency from sixty to several hundred thousand per second. The aerial from which the electric waves are radiated into space is 400 feet in length and is connected to the oscillation transformer.

We thus see that the standard time clock at the observatory controls the current which actuates the high tension transformer and therefore the output of electric waves. Each beat of the clock causes a train of waves to be radiated into space. Each group of waves is heard as a single dot at a receiving station so that it might be said, almost literally, that at each station the clock is heard to beat.

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*As a matter of fact, it is utterly impossible to keep a transit instrument in absolute adjustment. Slight differences of temperature cause varying expansion or contraction of the pier and thus throw it out of level, etc.

The plan of sending time signals which has been adopted for the present is as follows: Each afternoon beginning at 2:55, the clock beats are sent out. The beat is omitted on the 59th second of each minute up to 2:59:50. A break of ten seconds duration is then made which is terminated by a single beat. This beat therefore marks 3:00:00 P. M., and may be considered the essential signal, the others being merely preliminary.

After the switches are thrown at 2:55, everything has been arranged to proceed automatically with the exception of the breaking of the clock circuit for the omitted beats. In a short time this too will be automatic.

For the present, the transmitting equipment is good for about 150 miles during the day, but various changes now under way will greatly increase the range.

One of the advantages of wireless service of this nature is the freedom from interruptions which are common to ordinary wire telegraph systems because of storms, etc. The system is practically independent of weather conditions. It has been in operation since November, 1912, without interruption.

One of the purposes in taking up this work is the collection of data relative to radio-telegraphy by Prof. Culver, from a large number of receiving stations within our radius, which have agreed to furnish periodical reports. It is believed that data of some value can be secured in this way. Time is also being furnished to jewelers and manufacturers who need correct time.

The extended use of wireless time transmission will be of great value throughout the world. While its use on land may become very extensive, yet its principal value will doubtless be on the oceans. On shipboard it will be possible to obtain chronometer corrections to a high degree of accuracy, and this, in turn, will increase the accuracy with which the vessel's position is known. Such knowledge will be of value for charting purposes as well as in times of disaster, when it may mean the difference between life and death.

Recent Improvements in Aeroplane Design and What They Mean

By C. Dienstbach

ALTHOUGH there was seemingly a reason for the complaint that the recent aeronautic "Salon" in Paris showed too little progress, a closer inspection of the fifth of the great French aero shows fails to bear it out. It is true that a weeding-out process has started. The industry has settled down to the practical basis of catering primarily to military requirements, and the number of exhibitors has diminished.

The businesslike apparatus shown gave better proof of real progress than the freaks of former years. While types looked familiar, details of construction had all been developed from long experience in the exacting and practical flying demanded by the military authorities, and designs showed the work of the modern aerodynamical laboratory. This stamps as "practical" some entirely new departures, which looked too modest to command widespread attention, but were really of singular importance. Although inspired by military demands, they will eventually go far in commercializing the aeroplane by making it safer. Thus, an 80 horse-power monoplane ("De Beer") and a 160 horse-power biplane ("Paul Schmitt") were each provided with a perfected mechanism for changing the angle of the planes with the line of the propeller thrust and the fuselage during flight, for the purpose of being able to fly very slowly while making minute observations or dropping bombs and landing on difficult ground. Although any aeroplane can change its angle of attack by operating the horizontal rudder, this primitive method changes the line of the propeller's thrust just as much. The "slipstream" is then turned into a strong descending current which disturbs the normal action of the planes and rudders and impairs their lift. While the propeller itself becomes somewhat lifting, more harm than good is done, because at the steep angle of the planes every ounce of thrust is needed for propulsion. If fast flying did not waste so much power in overcoming the head resistance of struts and wires, which becomes clear gain with that resistance diminishing out of all proportion while flying slowly, the English War Office's prizes for moderately reducing the speed at will could never have been won by the machines competing. (Even the Gordon Bennett aeroplane race is now open only to such fast machines as can likewise cover a slow lap around the course.) With the new arrangement, a speed range of from 19 to 75 miles an hour is claimed for the big biplane.

In landing, the advantage of this arrangement is very obvious. At present the speed must be checked at some altitude when it is still needed for fighting the treacherous gusts of the lower air and in steering around obstacles. It cannot be checked instead just before touching ground (as the birds do) because the long fuselage is in the way. Nor can the machine's rolling after touching be quickly stopped without danger of a somersault while braking on the wheels or on the ground. The new arrangement, supplemented by a reversible propeller, permitting intense aerial braking, would easily provide for birdlike landings on any circumscribed area.

It is most significant that the famous designer of propellers, Chauvière, has brought out a propeller, the pitch of which can be changed during flight. It is only a matter of degree to make it entirely reversible. But before slow flying can reach its full development adjustable planes must be supplemented by changing the propeller's pitch, as actually provided for by Chauvière. It is a well known fact that a motor never develops its maximum number of revolutions while the machine is held stationary on the ground, yet could *do so if the propeller's pitch were reduced for so long.* The pitch must likewise be reduced lest the motor should become powerless in urging the machine against the excessive resistance of the steep planes. Even so, it needs a reserve of power, but surplus power is now so clearly recognised as a necessary condition of fighting the vicissitudes of the air with the primitive machines of to-day, that not a single French aeroplane now lacks a large margin of it. The new arrangements will rather tend to decrease the needed amount. They include also a larger size of propeller, lest in flying very slowly the slip should increase unduly. This requires in turn the efficient gear-drive shown in Caudron's large "seaplane." One of the "baby" Wright racers of 1910, with its enormous twin propellers, furnished a striking proof of the lifting power of a steep angle of the planes, supplemented by suitable propelling arrangements (behind the planes, beside the tail, and with a slow slipstream these large screws impaired the lift but little) when it established a height record in spite of small surface and was seen to start with the shortest run. Very slow flying obviously also demands enlarged rudders.

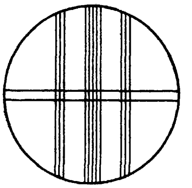


Fig. 6.—The spider threads of the transit instrument. The star is kept between the two horizontal threads so that each star is observed in the same part of the field of view.

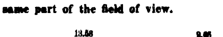


Fig. 7.—Part of a chronograph record. The consecutive numbers mark seconds. Two additional signals made by the observer at the transit instrument are shown.

The capacity to fly very slowly and fast at will provides more important advantages than the purely military ones. It permits starting with a very short run (little inertia needs to be overcome to raise the machine) and landing almost without any run. An aeroplane capable of starting and alighting on the roof of an ordinary house certainly goes a long step toward attaining the commercial machine of the future. But still better, it will eventually rob "stalling" and the "airhole" of their terrors. In descending currents a steep angle of attack will supply that sudden increase of lift a gull derives from its characteristic "periods of vigorous flapping." Getting more or less "stalled" means nothing to a machine capable of very slow flight, because little inertia needs to be overcome before it can lift and balance again.

Prize for a Non-Rubber Automobile Tire

THE Austrian War Department offers $10,000 as a prize to be awarded to the person who will, with adherence to certain prescribed conditions, construct an elastic tire for motor trucks. Besides the specific attributes of pure rubber, such as elasticity and adhesiveness, the new material must possess (1) essentially greater durability, or (2) with equal durability the attribute of essentially smaller cost of construction than the rubber tires, thereby reducing the expense of operating motor freight wagons. Its weight must not exceed that of the pure rubber tire. Competitors should hand in a model of the fabric in natural or reduced size, together with drawing and description, at latest by June 30th, 1914, at the *Automobil-Versuchs*[illegible] Division), VI. Gumpendorfer[illegible] ther details may be found in the [illegible] sches, published at I. Graben [illegible], Vienna, [illegible] had also on application in German to the [illegible] ministerium, Vienna, Austria.

The Introduction of Deodar Cedar [illegible] Its Uses

THERE are few trees about which there is [illegible] curious information as the true cedar [illegible] Himalayas. It is called the deodar cedar, [illegible] by some botanists to be merely a variety of [illegible] of Lebanon (*Cedrus libani*). The loftiness and [illegible]ing branches of this tree accord exactly with [illegible]scription of the cedar of Lebanon mention[illegible] sacred writings. The principal difficulty [illegible]ence to its being identical with the true cedar [illegible]anon is that it is not found at present on, [illegible] Mount Lebanon. This does not say that it [illegible] grow there in abundance formerly and subsequently disappeared. In India the tree is held sacred, and [illegible] some places it is not cut except on special occa[illegible], and then only for its wood for incense. The Hi[illegible] call the tree *devadera*, which means the tree of G[illegible].

It is a very large tree, often attaining a total [illegible] of from 100 to 150 feet and a diameter of from [illegible] to 12 or more feet. It has a life equally as long as the *Sequoias* and is tolerant to a marked degree of adverse conditions. It is one of the most drought resistant trees known, and will do better in poor, shallow soil than any other tree that can be made to grow. The deodar is sufficiently hardy to thrive in any part of the United States south of Delaware except at great elevations. Much encouragement has recently been given to its propagation in California, both for shade and ornament and for its timber. In southern California this tree is thriving at points where the thermometer often goes as low as 12 degrees above zero. One thousand deodar cedars have recently been purchased by the city of Los Angeles and planted in Elysian Park, where they are doing well. The city has thus far planted altogether about 10,000 trees of this species in Elysian and Griffith Parks.

About the year 1850 the English government imported an enormous quantity of seed from India and placed it in the hands of nurserymen, to cultivate, on condition that they should return one half of the product to the government at the end of three years. By this means about a million young seedlings of this very valuable tree were planted in England. This is an example well worth following in this country. The establishment of deodar plantations in favorable localities along the Atlantic seaboard of the southern States would serve as a splendid object lesson for those who wish to plant a valuable tree on land that is unfit for farm crops.

The deodar is planted extensively both in India and in Europe, not only because of its very great ornamental value, but also because of the superiority of its wood, which is compact, resinous, highly fragrant, of a deep rich color sometimes resembling polished brown agate. It is also of the most durable nature, instances being on record where its timber, employed in the roofs of buildings, was found perfectly free from decay after a period of nearly two hundred years. The records show that one piece of deodar used as a part of an old bridge in Cashmere, India, at the end of four hundred years proved to be very little decayed, although it was exposed to the action of the water. Pillars of it in the great mosque are said to be of the year 804 Hijri, and those on the Hindu temples are from six to eight hundred years old. Insects do not attack it. It is strong, elastic, and the average weight is only about 35 pounds per cubic foot. The wood has a remarkably fine, close grain, capable of receiving a very high polish, and in India is used for a great variety of purposes. It is used most extensively in the construction of houses and is regarded as one of the best woods for boat and bridge building. It is particularly desirable for the roofing of houses. The wood is very resinous, and is often cut into strips and used as candles.

A New Idea in Moving Pictures

POWERFUL arc lights combined with newly designed moving picture apparatus are used at the Scala Theater in London to produce some wonderful effects, for the persons are seen in life size moving about without the use of any visible screen, so that they appear to act upon a real theater scene which is lighted as is customary in such cases. This remarkable result is brought about by optical combinations which have as yet not been made public. The illusion is heightened by electric devices of an improved kind for working a phonograph together with the moving picture machine so that it always keeps in step, and the words or music are reproduced at exactly the same time as the pictures. It is said that the new apparatus does this with great perfection.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Architect of the Fisheries Building at the Panama Exposition

To the Editor of the SCIENTIFIC AMERICAN:

In the World's Fair article contained in your valued issue of the 6th ult. I observe that the writer accredited me with having been the "architect" of the Fisheries Building at the World's Columbian Exposition.

As this was in error I desire that the wrong impression be corrected as far as possible, insomuch as Mr. Henry Ives Cobb was architect and I served as designer-in-chief for Mr. Henry Ives Cobb in designing the Fisheries Building, therefore Mr. Cobb should properly be accredited with having been the architect of the structure and myself as designer.

San Francisco, Cal. L. C. MULLGARDT.

Twenty-five Knot Battleships

To the Editor of the SCIENTIFIC AMERICAN:

As to 25-knot battleships, and your recent editorial as to same, you write: "The large amount of weight which must be allotted to the motive power in order to secure 25 knots might better be given to armor protection, or guns. This would be in line with the policy we have wisely and steadily followed, where the speed is moderate and the armor and armament very powerful."

Your article states also that the 25-knot battleships of the "Queen Elizabeth" class have 14-inch armor, and that our latest ships have 13-inch. The "Queen Elizabeth" and sister ships have 15-inch guns. The biggest gun we have afloat or under construction is 14-inch.

The British 15-inch gun weighs 87 tons; projectile, 1,950 pounds. Our 14-inch might be under 60 tons; projectile, 1,400 pounds.

The British ships are several knots faster than ours; notwithstanding this they have heavier armor and bigger guns. The inference in your article is that our policy is to sacrifice speed for heavier armor and bigger guns.

Facts show plainly that the British ships are not only much faster, but have heavier armor and bigger guns. To a layman it is apparent that our ships are badly behind our British cousins in all essentials.

Also read article in same issue of your paper concerning the British battle-cruiser "Princess Royal." And that the speed curves worked out prove conclusively that with the power, said cruiser speed could not have exceeded 30 knots.

We have authentic data concerning other battle-cruisers, including the British "Indefatigable" and "Lion" and the German "Moltke" and "Von der Tann," all of which exceed 29 knots, and going to upward of 33.

San Francisco, Cal. C. P. SLOSSON.

[A discussion of the comparative efficiency of the "Queen Elizabeth" and our latest battleships will be found on the Editorial page.—EDITOR.]

Bacterial Versus Inorganic Fertilizers for the Soil

To the Editor of the SCIENTIFIC AMERICAN:

Mr. C. Cahall, in his article on the ten greatest inventions, as published in the SCIENTIFIC AMERICAN SUPPLEMENT of November 15th, mentions the artificial fixation of atmospheric nitrogen, laying especial emphasis on its relation to agriculture. Mr. Cahall is evidently mistaken as to the field in which the discovery he names will probably find its usefulness; for whatever may be its importance in a military or industrial sense, it is certain that it has little agricultural importance. While it is true that nitrogen is a very important plant food, and a very expensive one if bought in the nitrate *forms*, it is also true that it is so easily supplied from the atmosphere and from decaying vegetation that farmers have ceased considering it among their fertilizer expenses.

In 1886 Hellriegel discovered that certain bacteria found on the roots of leguminous plants had the power to fix atmospheric nitrogen. All leguminous plants share this property. Without the bacteria peculiar to themselves they cannot flourish; with the bacteria they not only flourish, but the nitrogen fixed by bacterial action is, at least in part, immediately available to plants other than the legumes, growing in the same field with them. Given a soil in good mechanical condition, and containing the elements other than nitrogen, a leguminous crop will not only make a good yield, but will, when harvested, leave in the soil sufficient nitrogen to supply a succeeding crop of any other grain. It is a fact well known among orchard men that a crop of peas, beans or vetch planted between the trees will supply them with all the nitrogen they need by fixing it from the free nitrogen of the atmosphere.

Farmers know also that fallowing a field, but especially sowing it to any kind of grass, will result in an increase of soil nitrogen. It may be safely stated that, other things being equal, soil nitrogen is proportional to the humus content of the soil in question, as bacterial action depends largely on the decay of vegetable matter. The place of humus in soil management is too large a matter to be entered into here; but it may be said that without humus there can be little bacterial action, and consequently little fixation of nitrogen. The trouble with commercial fertilizers is that they do not supply humus, and that soil soon becomes mechanically unfit for crop production, and bacterial action stops altogether. This is especially true of the action of the non-symbiotic bacteria, the Azotobacters, which depend for their support upon the carbohydrate content of the soil in which they live. Lipman quotes Kühn as saying that, after growing non-leguminous crops on the same soil (sandy loam) for twenty years, the yields became no smaller, notwithstanding the fact that only non-nitrogenous fertilizers were used. Similarly, in a portion of the Geescroft Field at Rothamsted, abandoned to itself between the years 1882 and 1904, and bearing no leguminous vegetation, there was an average annual increase of twenty-five pounds of nitrogen per acre. These experiments only confirm the experience of every farmer. The best results are obtained from the use of organic fertilizers, as bacterial action of all kinds is thus added.

In farm practice nitrification must be constant. The fugitive nature of nitrate compounds makes it practically impossible to use a sufficient quantity to feed a crop during the growing season, or at most more than a year at a time. On the other hand, atmospheric nitrogen, fixed by the soil bacteria, is constantly renewed and constantly available, but especially during the spring and early summer, when more nitrogen is needed than at any other time. The problem before the working farmer is not to find a new source of nitrogen, but so to manage his soil that he will tap the limitless supply in the atmosphere, and compel it to take its place in the life cycle of his crops, to be liberated and used again and again in the generations to come. Mineral nitrogen is expensive and often unsatisfactory; that derived from the atmosphere is usually a by-product of a profitable crop, and always leaves the soil in good condition. The nitrogen problem has no further meaning to the farmer. R. W. DAVIS.

Moline, Ill.

[We cannot agree entirely with the position taken by Mr. R. W. Davis. While it is perfectly true that a certain amount of nitrogen can be fixed by bacterial agents assisted if necessary by human aid, without the application of nitrogenous fertilizers to the soil, yet it is an undeniable fact that in the present order of things it is customary to apply such fertilizers to the soil, whether in the form of Chile saltpeter, ammonium, sulphate, or what not. Nor is it likely that these methods will ever be entirely supplanted by the bacterial method. For this last is necessarily somewhat slow in its action, and there are many cases in which immediate addition of considerable quantities of nitrogen to the soil is imperative.

Neither can it be said that Chile saltpeter and ammonium sulphate have in the past been applied to the soil merely because they happen to be convenient and available in a reasonably cheap form, and that this practice of using inorganic fertilizers will be abandoned if at any time the cost of Chile saltpeter becomes prohibitive. For at the present day, calcium cyanamide is actually marketed and put on the soil. The technique of cyanamide manuring is, in fact, at the present day well understood, and pretty thoroughly worked out. Cyanamide possesses many properties that render it highly desirable as a fertilizer. It forms an excellent dryer and conditioner when mixed with other fertilizing materials. At the same time there is one limitation to its use, namely, that in conjunction with superphosphates the proportion of calcium cyanamide permissible is limited by the fact that an excess beyond a certain amount tends to cause a reversion of the superphosphates. It may be stated that about 100 to 120 pounds of calcium cyanamide per ton is at present the maximum allowable for use in conjunction with superphosphate. If the phosphorus is applied to the soil in the form of steam-ground bones, somewhat more cyanamide may be used.

The application of nitrogen compounds to the soil directly and the fixation of nitrogen in the soil by the agency of bacteria each has its own special field of usefulness, and we can only gain by giving each of these methods the attention which it so well deserves. —EDITOR.]

The Current Supplement

THE current SUPPLEMENT, No. 1986, contains a remarkable number of readable and highly instructive articles. First of all Noel Deisch discusses the gyroscopic force in revolving cylinder motors and suggests how stability may be improved by altering the position of their axes of rotation.—How a Parsons steam turbine from one of the United States navy destroyers was rebladed is told by N. L. Mosher.—Dr. Felix Oswald's paper on "The Sudden Origin of New Types" is concluded.—To those who are interested in the technical aspects of Pégoud's flights we may commend a scientific analysis of that remarkable aviator's performances which appears in the current SUPPLEMENT.—W. F. Schulz describes stellar photometry by the use of the photo-electric cell.—"A Desolate Island in the Antarctic" is the title of an article by Robert Cushman Murphy, in which the great whaling grounds of South Georgia in the latitude of Cape Horn are picturesquely described.—Among the miscellaneous articles of interest may be mentioned those entitled "The Passivity of Metals," "Winter Troubles on Electric Railways," "Palæobotany: Its Past and Future," and "The Production of Animal Heat."

The Alliance Between Harvard University and Massachusetts Institute of Technology

IN the daily press there have already been set forth the outlines of the plan for co-operation in engineering studies between Harvard University and the Massachusetts Institute of Technology. These are in effect that for the four courses in applied science; namely, mechanical, electrical, civil (to which sanitary engineering is attached), and mining engineering (with which metallurgy is affiliated), Technology in its new plant beside the Charles will direct and actually conduct the studies and investigations, while Harvard will contribute of its funds. The University is to give up entirely its graduate schools of applied sciences (in these branches) and the funds now at their disposal will be paid out by the Bursar of Technology for instruction within Technology walls. The president of the Institute is to be executive head, and the Faculty of the Institute, the board to prescribe courses, etc. The latter is to be enlarged by the addition to it of the instructing staff of the University schools that are to be discontinued.

Efficiency is to be gained by this concentration of effort, an important step forward and in contrast to the prevailing educational custom in America of maintaining at great cost competing courses in the same departments in colleges that serve the same community. It is the community that pays for such things, and educational alliances mean material economies in cash besides those which the union of the faculties entails. With co-operation it is possible for the students of both institutions to have the advantages of strong men for instruction of a quality that it would be folly for each to maintain separately. The Tech.-Harvard alliance means a fuller utilization of the splendid men in both faculties for the benefit of the students in both colleges.

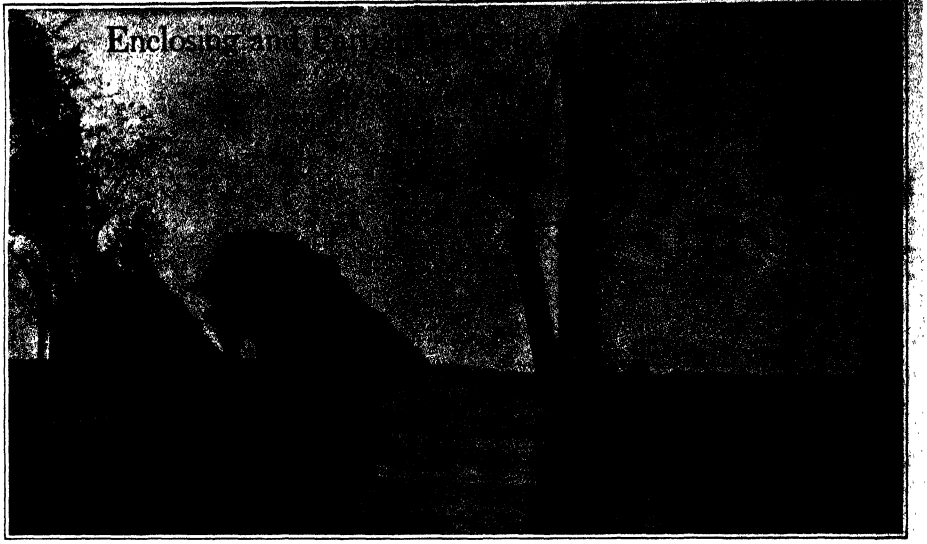
The general story has hitherto been of this nature, the benefit to the community. There is another phase which interests engineers, the question how the students are to be affected. The SCIENTIFIC AMERICAN is pleased to present this side of the case from President Maclaurin's address to the students of Technology at their recent convocation.

Here the terms of the agreement were commented on and three phases considered, the effect with reference to the corporation of Technology, the faculty and the students, respectively The corporation will have from the outset a little more money to spend, though not much comparatively speaking. The annual income of Technology is about $700,000, and Harvard will contribute about one tenth as much. The faculty will be affected only by the addition to its number of a few members from Harvard, not many.

The students of Technology will be affected very little. All the men for the engineering courses will enter the Institute together. At a certain time, as now, the question will be asked as to what course is to be chosen. If this be an engineering course in any of the departments affected, the further question will then be asked, as to which course, Harvard or Technology, is to be taken.

The student pursuing the courses in the Institute alone will not be in any way affected. If he should designate that he intends to follow the Harvard course, or both, which is by no means out of the question, he will then have certain advantages. He can go into the museums of Harvard and study if he wishes He will have the privileges accorded to students at the libraries of Harvard. Among the minor advantages will be the privilege of subscribing to the Symphony concerts in Cambridge, the use of the Stillman Infirmary (on payment of fee) and he can make use of the athletic field of Harvard. Among the important advantages will be the privilege of attending without fee certain Harvard lectures outside of the course selected.

Trunk Manufacturers in Colorado are abandoning the usual basswood and cottonwood for the trunk box, and are turning to Engelmann spruce, which combines lightness, strength, and ease of working.



FOR the benefit of the numerous readers of the SCIENTIFIC AMERICAN, Dr. C. Lely, Netherlands Minister of Waterways, most kindly explained his project for the reclamation of the Zuider Zee to the correspondent of this paper. His Excellency also gave two maps annotated by himself for publication in connection with this article, from which our artist has prepared the accompanying bird's eye view, showing future conditions when the Zuider Zee shall be reclaimed.

The possibility of the reclamation of the Zuider Zee first began to be talked about in 1840. In 1870, a royal commission was appointed to report on the embanking of the southern portion of the sea In 1875 the first sum of money was voted by Parliament to conduct borings in connection with the proposed draining; and in 1877 a bill was introduced for inclosing and draining the southern portion of the Zuider Zee, an area of about 888,000 acres; though this bill was withdrawn by the succeeding cabinet.

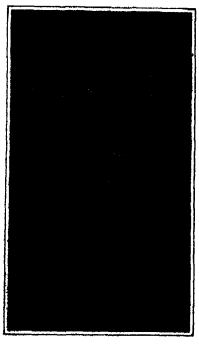
April 28th, 1886, saw the institution of the Zuider Zee Association, which has as its object the conducting of technical and financial inquiries about the constitution of an embankment preparatory to a partial draining of the Zuider Zee, the Wadden and Lauwer Zee. It is interesting to note that none other than Dr. Lely was the engineer under whose auspices were conducted all the technical inquiries of the Zuider Zee Association, and that the plan now to be laid before the States General is the identical scheme of the association, amended by the Royal Commission, which was instituted in 1894 to report upon it. Happily for the Netherlands the present year again sees the advent of Dr Lely as Minister of Waterways, and with him comes the most important plan yet proposed by any government, this being in fact the scheme of the Zuider Zee Association, as elaborated by Dr. Lely himself with the amendments of the Royal Commission. Dr. Lely says it will certainly enhance the importance of the country, and increase the means of subsistance of the people of the Netherlands. The greatest difficulty will be the laying of the embankment* of 20,300 meters in length from Ewyk Sluis, near Wieringen, to Piaam in Friesland. This is to be built in water averaging 3.6 meters in depth below ebb level The deepest point, the Amstel Diep, between Wieringen and North Holland, is 10 meters below ebb level. The height of the summit of the embankment is to be 5.2 to 5.6 meters above Amsterdam level. This embankment which is to broaden considerably toward the base is to carry on the inner or Zuider Zee side a double-line railroad and a road for ordinary traffic. Its construction is estimated to take 9 years. It is proposed to commence operations by strengthening the ground on the place where the embankment is to stand, in order to prevent scour when the channel is being closed.

Communication with the North Sea will be by thirty-three 5 by 6 sluice-gates, in the very wide canal to be dug through the Island of Wieringen. The combined width of the sluices will be 300 meters, the depth 4.4 meters, Amsterdam level These sluice-gates will make it possible, in ordinary circumstances, to keep the water level at the present time in the southwestern corner of the Zuider Zee. Besides the thirty-three sluice-gates in Wieringen, there will be two locks, a large one and a small one, for the traffic Within the embankment, four areas are to be drained, each of which is to be apportioned to the province which it adjoins.

I. The northwest area is 54,270 acres in extent. Of this part, 46,800 acres is clay or sandy clay II. The southwest area is 78,800 acres, and of this part 69,560 acres is clay or sandy clay. Both these areas adjoin North Holland. III. The southeastern area adjoins Gelderland. It is 269,410 acres in extent, and of this part 229,977 acres is clay or sandy clay. IV. The northeastern area adjoins Friesland, and is 127,125 acres in extent, and of this part 124,260 acres is clay or sandy clay. The total area of land to be gained is 529,605 acres, of which 486,025 acres is clay or sandy clay. The rest is fen and sand. The area of fertile land will be equal to eleven or twelve times the area of the reclaimed land, known as the Haarlemmer Meerpolder. The depth is 4.5 meters below Amsterdam level, this being a little less on an average than the Haarlemmer Meerpolder. Inside the embankment will be left a large lake, the Ysselmeer, the bottom of which will, for the greater part, consist of sand. Its area will be 358,295 acres. This large lake will be needed to serve as a storage reservoir for the water flowing into it from the Yssel and other sources. It must be large enough to serve this purpose, even when high tides prevent the discharge of water from the lake into the North Sea through the 5 by 6 sluices at Wieringen.

In this way a fresh water lake will be formed, from which the surrounding districts can at all times procure fresh water. In times of drought, in summer north Holland now takes in brackish and dirty water from the North Sea canal and in the north also sea water from the Zuider Zee. Salt water often causes diseases in cattle and is a drawback in cheese making. In dry times Friesland has no supply of fresh water. Owing to the want of grass and water the cattle have to be taken to their stalls and the production of milk becomes smaller. Navigation is hampered in consequence of the fall of the water. The small quantity of water in the canals, etc., soon gets brackish, especially in the west of the province owing to the busy traffic through the locks at De Lemmer, Stavoren and Harlingen. This has a not very wholesome effect upon the cattle and upon the dairy produce, and does a great deal of harm to the fisheries in the inner waters and to several industries, boilers having to be cleaned oftener than when fresh water is used. The large fresh water lake will render possible a more effective draining of the land, because, with a large

Typical Dutch architecture in Monnikendam.


Isle of Marken young folk.

The church tower is a landmark for the Zuider Zee fishermen.

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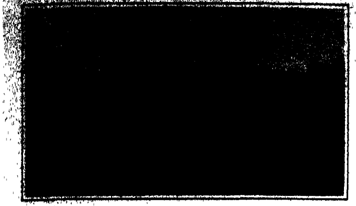
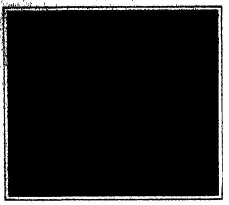
* This great embankment is to be built of sand, not of concrete.



Volendam on the shores of the Zuider Zee.



City fathers of the Isle of Marken.

Fishing fleet in the harbor of Volendam.

supply of fresh water always at hand there can be no harm in letting the water run to a very low level in spring. At present this is hardly possible because summer droughts may cause a scarcity of water. The Ysselmeer will raise the value of hundreds of thousands of acres of grasslands in the surrounding districts by rendering the draining more perfect, preventing want of water and improving the dairy produce. The rise in value will probably amount to from $2 to $4 rent per hectare (2.47 acres). The inclosing will further improve the drainage of some districts because the water level of the Ysselmeer will be less variable, and on an average lower than the Zuider Zee level. The navigation will be rendered safer because the water will be smoother and the Zwolsche Diep will be improved. It will lessen the cost of upkeep of water defenses because long lengths of sea-dyke will no longer be wanted and no damage will be done by floods in Overyssel and the north of Gelderland. Besides all these advantages a railroad connection will be provided between north Holland and Friesland. But the greatest advantage of all will be the acquisition of a great area of fertile land.

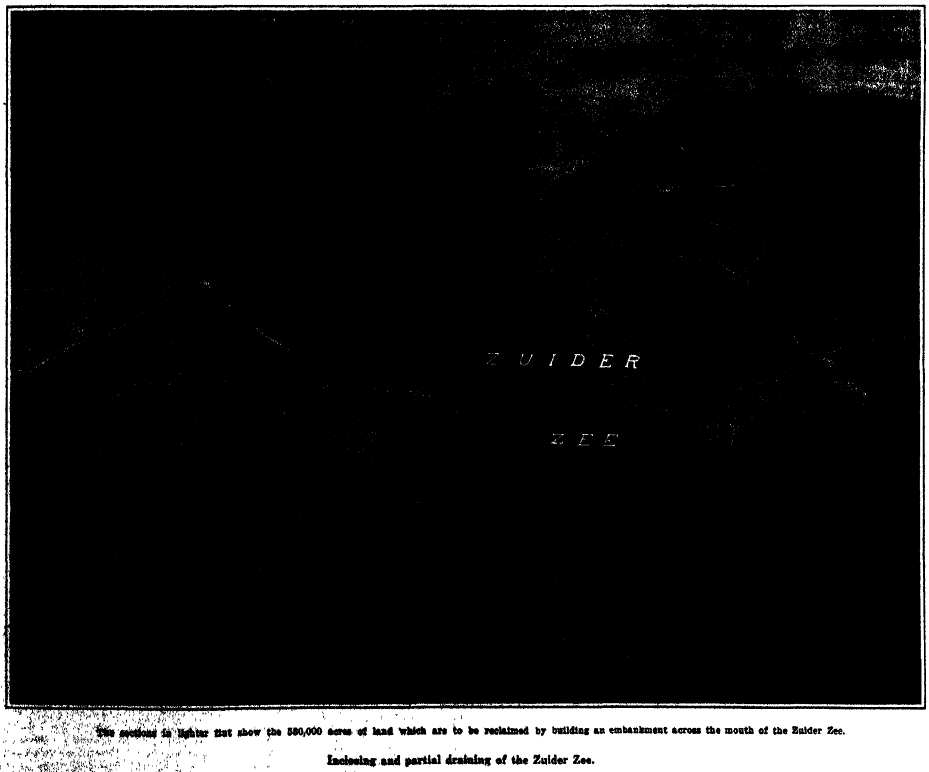
The existing shortage of land, as shown by the annual returns is due to the fact that the increase of the population, both rural and urban, goes on at a much quicker rate than the acquisition of tillable land. Assuming that, as in the case of the Waard and Groet Polders and the Y Polders, very little of the clay in the Zuider Zee Polder will make permanent pasture, the cultivation of the land will require at least 40,000 peasants, including the laborers. To this number we must add peasants families and some 50,000 tradesmen, handicraftsmen, etc., to get the total number of 250,000 workers, who will find ample means of support in the new Zuider Zee province. In 1907 the rent of clayey land in the Waard and Groet Polders was $40 to $60; of light clayey land, $28 to $36 per hectare. In the Anna Pawlown Polder the rent of the light sandy soil was $20, and that of heavy sandy soil $36 per hectare.

Supposing the average rent of the Zuider Zee areas, where the soil will be much like that of the Waard and Groet Polders, to be only $30 per hectare, we may estimate the total amount of the rentals at $6,000,000 a year. The value of the fish caught in the Zuider Zee is a little over $8,000,000 annually. The value of the crops grown on the drained Zuider Zee areas will be $28,000,000 a year. Canals for use in navigation and for the regulation of the water-level will be dug along the coasts in north Holland, coast of Gelderland and that of Friesland.

The time needed for the work will be thirty-three years, and the embankment, which is to be built of sand, will take nine years. By the end of the fourteenth year, the first land will have been reclaimed, in the northwest area, and in the seventeenth year, portions fit for cultivation and habitation will be offered for sale. The cost will not be prohibitive, some $2,400,000 or $2,800,000 annually, the whole cost of the undertaking being estimated at $75,600,000, exclusive of interest; inclusive of cost of military defences, improvement of the Zwolsche Diep, accumulation of capital to defray the cost of dredging sand and silt from the Yesselmeer, compensation to the fishermen, etc. The reclaimed land is to be government property, and it will be offered for sale, but no certainty can yet be given about which system is to be followed in apportioning it.

Many economists are of the opinion that this would be a good opportunity to make a commencement with a system of small allotments which is now deemed so necessary by them, for the welfare of the agricultural population, and for the prosperity of the entire country.

The Latest Change in the Map of Africa is the amalgamation of Northern and Southern Nigeria into the single colony of Nigeria, dating from about January 1st, 1914. The new colony has an area of 332,000 square miles and an estimated population of 18,000,000.



The sections in lighter tint show the 580,000 acres of land which are to be reclaimed by building an embankment across the mouth of the Zuider Zee.

Inclosing and partial draining of the Zuider Zee.

The Gyroscope in China

An Interesting Y. M. C. A. Lecture That Always Fills the House

By Prof. C. H. Robertson

IN China's series of revolutions since 1900 western science and Christian missions have had great influence. The dynamic combination of these two is well represented in the science lectures that have gone out to the distant parts of the Empire-Republic from the lecture laboratory of the National Committee of the Young Men's Christian Associations of China.

No subject has been more popular than the gyroscope monorail car, as is the meaning of the title shown in Fig 1. It is pronounced "Pang hsuan chi tan kuei chue" The magic of this name and the elaborate equipment used to demonstrate its principles have drawn tens of thousands of Chinese students, educators, and officials to applaud the fascinating experiments used in the lectures on this unique subject.

In Fig 2 are shown pieces used to give the underlying principles. The chain on the wheel *A* attached to the rotator shows beautifully the tendency of the links to travel in a straight line due to inertia (the first law of motion). The experiment consists in spinning the wheel up to high speed and then forcing the chain off. When it strikes the floor it does not collapse, but stands up like a hoop made of spring steel and will skip across the stage at high speed until its energy is consumed.

Many interesting and surprising experiments may be made with this one piece of apparatus. For example, if when the chain is forced off, it is caught in a large shallow metal pan, and held at a sufficient slope to prevent the chain running out, it will spin around in a stationary position. If then, the pan be rotated on its center, the chain loop, due to its inertia or persistence of plane, will spin as before and will not be rotated by the turning of the pan.

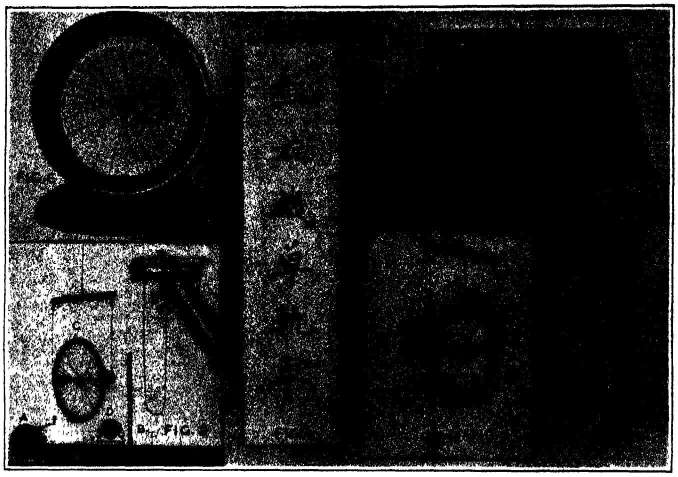


FIG. 1.—The gyroscope monorail car in Chinese. FIG. 2.—Apparatus used in demonstrating the principles of the gyroscope. FIG. 3.—Illustrating the principle of precession in rotation of shaft. FIG. 4.—Showing path of the particles in a quadrant. FIG. 5.—The wrestling gyroscope. FIG. 6.—The construction of the wrestling gyroscope.

Apparatus for a lecture on the gyroscope, used by the Y. M. C. A. of China.

While making some preliminary experiments one day in a long church in the interior of China, the chain was run down from the stage on a board and happened to strike the back of a pew. To the surprise of the writer, it jumped from this to the back of the next one, and the next, and so on, the length of the room. Surprising as it may seem, it will invariably do this if the pews are spaced properly and the chain strikes the first one within a reasonable distance of a certain position and speed. Over a wide range it automatically adjusts itself both as to distance between the seats and as to the distance below its own center at which it strikes. The lower it strikes, the higher and farther will its next jump be. This in turn results in its striking the next one more lightly and not jumping so high, nor so far. After two or three jumps it will come to a state of dynamic equilibrium and skip with great regularity from point to point. This immediately suggested a second experiment—placing a step ladder at an angle of about 30 degrees at the edge of the stage. When the loop strikes the first step, it will jump to the next one, and so on upward until it jumps off the top. This has been an extremely interesting experiment to both Western and Chinese audiences.

If a considerable obstruction, like a folding chair placed upside down, is placed in the path of the loop when running on the floor, it will after striking at high speed, jump several feet in the air, and when it comes down it will not collapse, but will spring up again from contact with the floor, due to what might be called its dynamic elasticity.

The apparatus at *B* (Fig. 2) consists of a larger chain loop suspended by a fine steel piano wire, which may be rotated at high speed through the medium of the flexible shaft, twisted string and rotator. The first effect, due to the tendency of matter to travel in a straight line (centrifugal force), is for the links to move out as far from the center as possible. This still leaves, however, the links at the bottom rotating in small horizontal circles, and it requires but a slight acceleration of speed to cause them to rise in opposition to gravity until the chain is opened out into a complete circle and revolving at high speed in a horizontal plane. It so spins with great steadiness, even though the hand be slid down the wire and much shortening it. If the chain be struck on the side, its circular shape is somewhat altered, but it will so continue with much persistence.

The wheel *C* (Fig. 2) is the result of many attempts to get a satisfactory portable gyroscope of large dimensions capable of being seen clearly by audiences of from one to three thousand people. By reference to the illustration it will be seen that a heavily rimmed wheel is suspended from the ends of a horizontal lever with a fulcrum at the middle. It is used in many interesting experiments. These may begin by clamping the lever across the square frame in place of the chain. If while the wheel stands still one of the end supports be detached, that end of the shaft immediately falls down until it assumes a vertical position. If now the wheel be replaced with the shaft in a horizontal position, and spun up, then when one end is released, instead of falling it immediately begins to precess with the shaft in a horizontal plane. If the speed of precession is accelerated by a little help from outside, the wheel rises up against gravity. If the precession is retarded, it will drop down to a lower plane and will continue these motions for a considerable time. An interesting variation of the same experiment is then made by resting the ball on the end of the shaft in a ball-bearing cup supported by a tripod stand. To hang a large pasteboard box or derby hat over the outer end of the shaft while it is moving around helps a popular audience to realize that there is a remarkable force manifested by such an apparatus.

The audience is always greatly delighted to see some representative from its own ranks trying the strength of the gyroscope by holding the wheel by its shaft, either both hands on one ball or a hand on each ball, and trying to change the plane of rotation at the same time keeping the shaft in a horizontal position. After these preliminary experiments, the mechanism is balanced by sliding the smaller ball (which acts as a counterweight as well) back and forth on the shaft. It will then hang in a horizontal position. If when in this position, and the wheel is standing still, a heavy weight is added to one end of the shaft, that end immediately descends. If now the wheel is spun up and the weight again added, it does not fall, but results in a precession of the shaft about the center of support in a direction depending on the end to which the weight is attached, and the direction of the rotation of the wheel. This leads the way to an explanation of the gyroscope principle.

For this purpose arrows are used, as shown by Fig. 3—*b* represents the direction of rotation of the wheel and *a* the force or weight, which applied to the end of the shaft starts its precession in the direction pointed by the arrow. If now the wheel be considered as divided into four quadrants, *bc*, *cd*, *de*, *eb*, the effect of adding the weight will be to cause the particles in the quadrant *bc* to have a tendency to move out from the plane of the paper toward the reader. This path of the particles is illustrated in Fig. 4. The bead *f* is attached to the wheel, and as it goes through the quarter-revolution from *b* to *c* the resultant tendency due to the weight *a* and the rotation *b-c* is to take up the curved path represented by the white-headed beads going from *b* to *c*. Now if the bead *f* be returned again to the point *b* and we concentrate our attention upon the simultaneous motion of *g* through the quadrant *cd*, we see that, due to the weight *a*, it will first have a tendency to move out from the plane of the frame (which was the original plane of rotation), but due to the fact that the wheel is pivoted on the axis *bd*, it must as a result of the wheel's rotation finally come back again to the original plane of motion at the point *d*. This at once puts us in a position to realize that the path through which the particle *f* in the quadrant *bc* tends to move (due to the action of the weight *a* and the rotation of the wheel) is quite different from that of the particle *g* as it simultaneously moves through the quadrant *cd*. It is of great importance that this be clearly perceived, because the resulting reactions that the particles develop are the forces that make the gyroscope do all of its wonderful and almost incredible antics; and also from which comes its great promise of many practical applications.

This leads to the question, What are the reactions? The question is very simply answered. Particle *b*, when it starts moving from the beginning of the quadrant *bc*, is moving in a definite plane. If at this time the weight *a*, Fig. 3, is applied, tending to take it out of its plane, it will resist by trying to stay in the plane, due to its momentum or tendency to travel in its original plane. This is true of every particle in the quadrant, and the summation of all the reactions in that quadrant may be represented by the arrow *h*. A little consideration will show that for the first part of the quadrant *cd* there is another *force* (represented by the letter *i*), which when the particle starts back toward the plane changes to a force in the opposite direction (represented by *j*).

A more detailed and exact analysis for the quadrant *cd* shows the summation of the forces represented by *j* is a little greater than those represented by *i*, and this is shown graphically by making the arrow *j* longer than the arrow *i*. A moment's thought will suffice to show that the forces in the quadrant *de* (represented by the letter *k*) are equal to and opposite in direction to *h* in the quadrant *bc*; for the quadrant *eb*, *l* and *m* are equal and opposite to *i* and *j* for the quadrant *cd*.

Up to this point we have been considering the motion of the wheel about the axis *bd*. It should be remembered, however, that it is free to move in any direction on any axis, according to forces brought to bear upon it. Let us, therefore, consider the tendency to move about the axis *ce*, Fig. 3. Viewed from this point, we see that in the left half of the wheel *e b c* the summation of the forces is a strong one into the plane of the paper away from the reader, and the summation of the forces on the right half of the wheel *c d e* is a strong one tending to cause the plane of the wheel to move out from the paper toward the reader. If now all these forces *h i j k l m* be replaced by one single force, represented by the arrow *n*, we have arrived at a very important and far-reaching principle—namely, an explanation why, when the force *a* is applied to the shaft of a rotating wheel, the shaft does not move in the direction of the force, but at right angles to it. This conclusion may be stated in the form of a very simple but important rule: "When a force is applied at right angles to the shaft of a gyroscope, the direction of motion of the shaft may be found by rotating the force through 90 degrees in the direction of rotation of the wheel. This second position will be the direction of motion of the shaft resulting from the force." That is, in Fig. 3 force *a* is applied to the shaft when the wheel is rotating in the direction *bc*. If the arrow *a* be turned with the wheel 90 degrees until it comes to *n* it will show the direction the shaft will move. This explains the precession force and direction and puts us in a position at one step to account for the greater mystery of the gyroscope, namely, Why does it not fall under the action of the force *a*? We must remember that the force *a* has developed force *n* at right angles to it and to the shaft; and applying the same rule and the same reasoning up to this point, the force *n* must develop a third force *o*. But one is immediately tempted to ask, Where is this going to end? We begin with force *a* and get a force at right angles to it in the direction *n*; *n* then develops a force at right angles in the direction *o*. The answer is, that the thing ends right there. Because both theory and experiment indicate that, neglecting friction, the force *o* being equal and opposite to the force *a*, they will therefore balance, leaving the force *n* as the one which acts and causes the rotation, which is technically known as precession, at right angles to the first force *a*.

If one wishes further details he may refer back to

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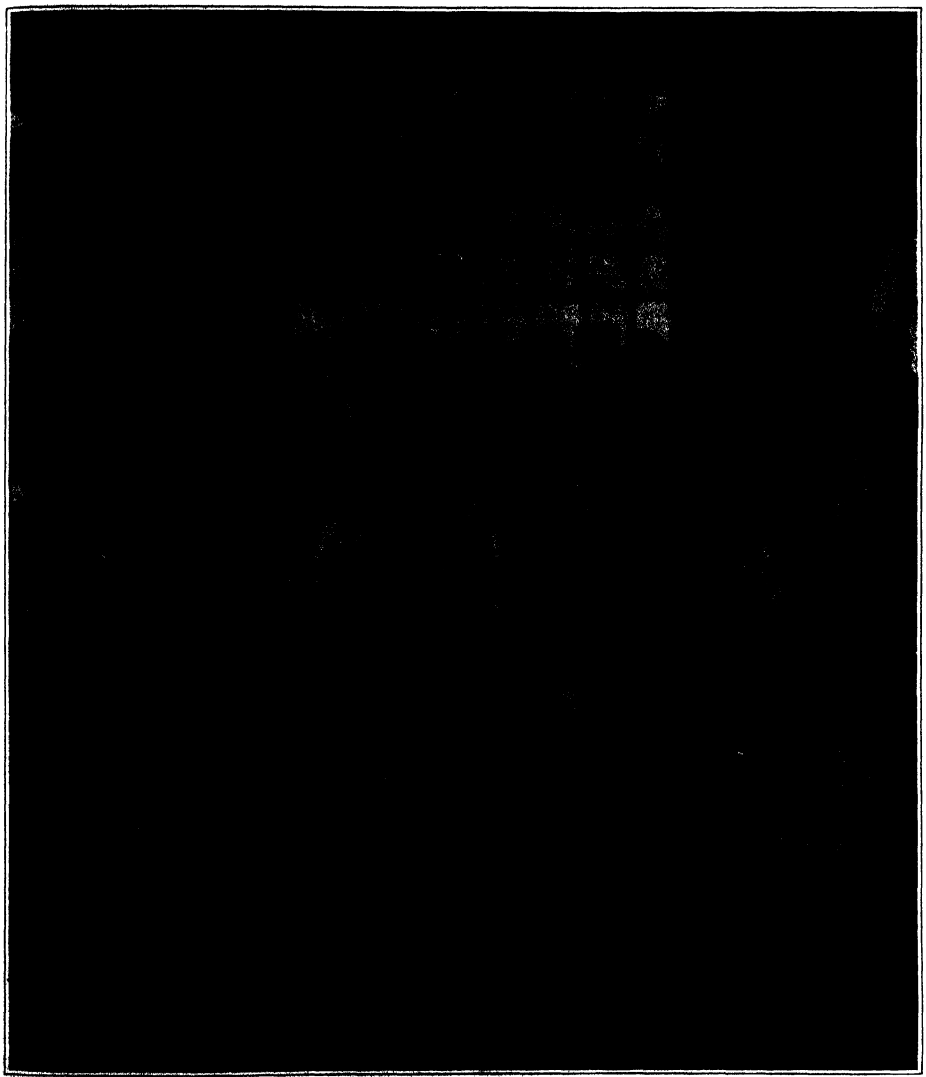


Compare this picture with that appearing on our cover. By a light pressure the lecturer downs the "wrestling" gyroscope, which no two men in the audience were able to overturn.

The Unsinkable Ship

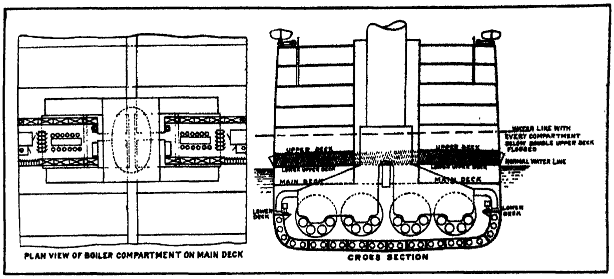
Notable Naval Architect's Design for a Ship That Will Not Sink

TAKING the "Great Eastern" as its text, the SCIENTIFIC AMERICAN at the time of the loss of the "Titanic" stated that it was entirely feasible to so build large passenger ships that they would not founder even under such severe a mishap as befell the "Titanic."

At the last meeting (December 11th and 12th) of the Society of Naval Architects and Marine Engineers, its vice-president, one of America's best known naval architects, gave a paper with plans entitled "On the possibility of building a large passenger liner that would not, under any of the known mishaps at sea, lose her *buoyancy or stability* and sink."

We present the plans and the following digest of his paper with the conviction that not only would it be unnecessary for such a ship to carry lifeboats; but both in construction and operation it would be an engineering and commercial success.

This paper seeks to point out a possible solution of the problem as applied to a certain type of vessel, viz., the large, modern, passenger liner. New and ever increasing laws concerning life-saving appliances have created a grave problem for the naval architect, both as to carrying heavy top weights and littering a large area of deck space with life boats and rafts. In brief, the suggestions embodied are the fitting of a double upper deck and so arranging the watertight subdivision below the lower member of this deck that the ship would prove both seaworthy and unsinkable under the most aggravated conditions of flooding. The advantages to be considered in this arrangement as opposed to the drawback of wasted space are as follows: The space between the two members of the upper deck would be utilized for cold storage rooms, air ducts, water and steam piping, stores, etc. The fire mains would at all times be under direct control. All horizontal piping and ducts through living spaces would be done away with. Communication to and from engine room, fire rooms, dynamo room, and ventilating and refrigerating rooms would be through a continuous watertight passage fitted with automatic watertight doors which would operate from the influx of the sea.


PLAN VIEW OF BOILER COMPARTMENT ON MAIN DECK
CROSS SECTION
WATER LINE WITH EVERY COMPARTMENT BELOW DOUBLE UPPER DECK FLOODED
NORMAL WATER LINE
UPPER DECK
LOWER UPPER DECK
MAIN DECK
LOWER DECK

Section and plan views of an unsinkable ship.

In a ship so constructed and practically, at least, unsinkable, would it be necessary to carry the great number of lifeboats now deemed necessary which, with the great freeboards of our ocean liners, are utterly useless except in the event of a moderate sea and the speedy arrival of assistance?

The question of designing a ship that cannot be sunk by any of the known accidents which befall vessels at sea cannot be treated in a general way. The conditions are so varying in different types of vessels that the only way to handle the subject is to assume a certain type and work out the problem in its relation to the assumption, which is what I propose doing in this paper. I have taken a typical large passenger steamer of the following dimensions:

Length between perpendiculars.......	800 feet
Beam, molded	90 feet
Draught, loaded	33 feet

With a coefficient of 0.64 these dimensions would give a load displacement of 42,180 tons. There would be a complete double bottom, the inner shell being 4 feet from the outer skin, extending from the fore peak to the after peak and up the sides to the lower deck, which would be 15 feet above the base line. The main deck would be 9 feet above the lower deck and the upper deck 9 feet above the main deck amidships and would extend parallel to the base line from frame 87 to frame 233. From frame 87 to the stem, this deck would slope down, touching the stem at a height of 26 feet above base, and from frame 233 it would slope downward aft, touching the stern frame at a height of 27 feet. There would be twelve bulkheads extending from the inner bottom to the upper deck. These would be absolutely watertight, without any doors or openings whatever.

I think it will be admitted that this ship could be considered safe from any injury to the bottom below the lower deck and that danger of sinking would arise from rupture of the skin above the lower deck and under the water line, which is at the upper deck line. Such danger would arise from collision with another ship at such an angle as would cause penetration, or through striking some stationary mass between the lower and upper decks, opening up several compartments to the sea as in the case of the "Titanic."

Let us first consider penetration by collision. Here the damage would be vertical and might, if the striking vessel were large and nearly at right angles, penetrate quite a distance into the side of the vessel. I think, however, that such a disaster could not entail more than three adjacent compartments if near amidships, or say 219 feet 6 inches. What would be the condition with three adjacent compartments near the center of this vessel flooded? The capacity of one of these compartments would be 163,345 cubic feet, from which would have to be deducted the displacement of the boilers, less furnaces, tubes and combustion chambers, or 13,120 cubic feet. The coal capacity would also have to be deducted, for if half the coal were used the vessel would be 3,000 tons lighters, and if the coal were all on board it would displace so much water, and for this we must deduct 52,000 cubic feet and also 1,740 cubic feet for a central watertight passage under the upper deck. This leaves 98,225 cubic feet or 2,806 tons for each of the three compartments that we consider may be possibly injured through collision, or 8,418 tons to be carried by new displacement. In order to provide the displacement for the condition described above, I would propose to fit what I would term a double upper deck, the upper member of which would be 5 feet 6 inches above the lower amidships and parallel to the base line between frames 66 and 254, at which frames it would rise 2 feet and follow the sheer line to the stem and stern. In case of a collision cutting into the upper member of the upper deck the local damage would be confined practically to the depth of penetration and the width of the striking ship, as the space between these decks would be divided into very small compartments both transeversely and longitudinally. As it is, we have between these upper decks 9,730 tons of displacement which, in case of three compartments being opened to the sea, would leave the upper member still materially above the water line. If the injury was near the forward end of the ship, the lower member of the upper deck extending downward reduces the size of the flooded compartments and the displacement of the contents of the holds, at least 50 per cent would still further have to be deducted, while the upper member rising at frame 266 and following the sheer line would provide sufficient displacement to trim ship till water could be introduced into the double bottom aft. These same conditions would apply in case of serious injury aft. It will be understood, of course, that all openings through the upper deck, such as boiler and engine casings and hold hatches, would be watertight structures for at least 16 feet above the load water line.

We come now to another form of disaster, the ripping open of the side of a ship for a considerable proportion of her length by striking the projecting edge of some obstruction under the water line. In the case under consideration this might happen between the lower and the upper deck for a great portion of the vessel's length. The five large compartments would add 14,030 tons to the displacement, while the forward holds, assuming that the cargo occupied one half the space, would add 3,800 tons more, and the after compartments, if they had to be flooded to trim ship, would add 3,400 tons, a total of 21,000 tons. This would sink the vessel 11.86 feet, or 6.36 feet above the upper member of the upper deck amidships, and she would then draw 43.86 feet. This assumption is to the very limit of the possibilities, yet, for an unsinkable ship, it should be provided against in the design. Between the upper member of the upper deck and the shelter deck there should be no air pores or side lights or if lights are fitted they should not be arranged to open and the glass should be cast around a wire mesh as a protection against cracking.

The objection that would naturally present itself to this type of vessel is the apparent waste of space between the upper decks. This space, however, need not be wasted. Forward of frame 66 this space is 7 feet

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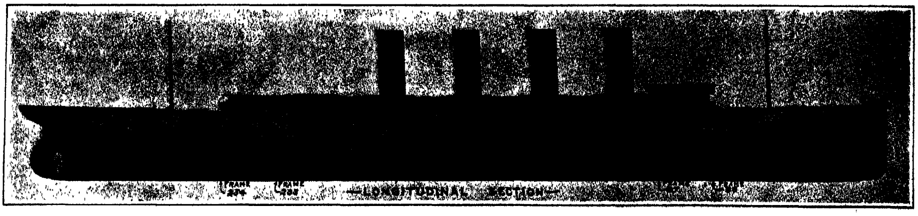


This ship is rendered safe against either sinking or capsizing by the provision of a double cellular watertight deck at the waterline. If the whole bottom of this ship were ripped open she would settle and ride upon this double deck as upon a second double bottom. Such a ship would be her own lifeboat

General plan for an unsinkable ship.

A [illegible] Electromagnet

By [illegible]

THE most powerful electromagnet in the world was recently installed in the laboratory of Prof. Jean Becquerel, in the Paris Museum of Natural History. This electromagnet, which was constructed by Prof. Pierre Weiss of the Zurich Polytechnicum, is capable of producing a magnetic field of 50,000 gausses, at least.

The three most powerful electromagnets which are now in service—in the laboratories of Prof. Weiss in Zurich, Prof. Kayser in Bonn, and Prof. Ames in the United States—produce fields of only 45,000 gausses.

The great power of the new electromagnet of the Museum of Natural History has been obtained by the use of various artifices, and is the result of a series of improvements. The employment of ferro-cobalt in the construction of the pole pieces contributes largely to the result.

In their study of the ferro-cobalts MM. Weiss and Preuss found that iron, having an atomic magnetic capacity of 11, and cobalt, having a capacity of 9, unite to form a ferro-cobalt of definite composition, which possesses an atomic magnetic capacity of 12. In other words, the magnetic strength of this alloy, when magnetized to saturation, is about 10 per cent greater than that of iron, at ordinary temperatures. Using Swedish iron and commercial cobalt, 98.5 per cent pure, as their raw materials, Weiss and Preuss obtained, in different castings, gains of 9 and 9.7 per cent, instead of the 10 per cent gain of the alloy of definite composition. The ingot that gave the smaller increase, 9 per cent, was more compact than the other, and from it the tips of the pole pieces were cut, as the ingot was too small to furnish material for the whole of the pole pieces.

With these ferro-cobalt tips, separated by an interval of one millimeter, the electromagnet, using 22 kilowatts of electric power, developed a field of 55,000 gausses in the intrapolar space. With iron tips a field of 52,000 gausses was obtained in the same conditions, so that a gain of about 5 per cent resulted from the employment of ferro-cobalt. With the ferro-cobalt tips and an intrapolar distance of 2 millimeters, fields varying in intensity from 42,000 to 49,900 gausses were obtained.

In the last-mentioned case the volume of the intrapolar space amounted to about 14 cubic millimeters, sufficient for the introduction of a spark-gap, a little flame, or an absorbent medium. When the intrapolar space was reduced to 0.5 cubic millimeter, which sufficed for the introduction of a particle of radium, a magnetic field of 75,000 gausses was developed.

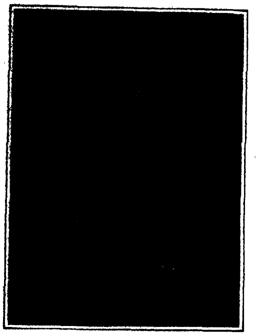
The electromagnet is wound with 1,000 turns of copper tubing, the walls of which conduct the electric current, while the interior serves as a conduit for a cooling stream of water. In order to accommodate the copious flow of water required for refrigeration, the tube is divided into ten sections, which, though electrically connected in series, form ten parallel water conduits. The flow of water is 6 liters per minute and the maximum heating is 50 deg. Cent. The cold water flows first through the innermost tubes, so that the core is always cool. The apparatus attains its normal working temperature in two minutes and maintains it indefinitely. In consequence of this construction it will be possible to operate the new electromagnet continuously for 24 hours. No other electromagnet can be used continuously for more than two hours.

The first experiments that Prof. Becquerel purposes making with this powerful apparatus will have for their object the elucidation of some obscure points in the theory of the Zeeman effect. "It is well known," Prof. Becquerel said to the writer, "that there is something yet unknown in this phenomenon, something that is at the limit of visibility with our present instruments. With the aid of my new electromagnet and its few thousand additional gausses, I hope that I shall be able to make visible this phenomenon, which explains the intimate structure of matter. Molecular and atomic life will reveal, perhaps, part of its secret. When these experiments have been completed I shall continue the study of the effects of magnetic force on matter, in rapid conditions of temperature and pressure."

The hope that an electromagnet of vastly greater power, even of a million gausses, may be constructed by international co-operation in a not too remote future, was expressed at the last International Congress of Electricians. According to Ch. Ed. Guillaume, adjunct director of the International Bureau of Weights and Measures, and M. Jean Perrin, professor of physics at the Sorbonne, the total cost of such an electromagnet would equal that of a modern naval "dreadnought," that is to say, 12 or 14 million dollars, and its construction would require the work of several years.

Still more recently, however, at the Chicago meeting of the International Congress of Refrigeration, the distinguished French engineer and physicist, Georges Claude, proposed to employ low temperatures for the production of an intense magnetic field. The electrical resistance of metals at low temperatures is very small. Hence it should be possible to construct a coil, without an iron core, which would produce at low temperatures a very strong and uniform magnetic field of considerable extent, without employing very strong currents or incurring prohibitive expense.

MM. Kammerlingh Onnes and Georges Claude estimate that twenty thousand dollars would cover the cost of an apparatus capable of producing a field of one million gausses at a very low temperature. M. Claude has subscribed two thousand dollars, and Prof. d'Arsonval two hundred dollars of the required amount.



Prof. Jean Becquerel, who purposes making the first experiments with the new electromagnet.

The new electromagnet of the Paris Museum of Natural History, which produces a magnetic field of 50,000 gausses.

Manufacturers of artificial limbs are seeking substitutes for English willow, used because of its lightness and strength. It is claimed that the Port Orford cedar of the Pacific Coast will prove equally serviceable.

An Extemporized Railway Drawbridge

How They Solved a Knotty Problem at Panama

WHEN the Chagres River at Panama is at flood, it brings down from its upper reaches a large amount of detritus, a considerable part of which consists of a kind of gravel which is dear to the heart of the constructing engineer.

Visitors to the Isthmus who are of an inquiring and observant bent of mind, may have noticed not far above the railroad crossing of the Chagres, certain excavators at work upon large beds of gravel. Now that Gatun Lake has risen to its full height of 85 feet, the Chagres at this point and for many a mile above the railway is submerged; and the clear headway between the water and the underside of the bridge is of course considerably reduced.

Recently it was decided to move a dredge up stream and set it to work excavating from the gravel beds of the Chagres River. The dredge was too high to pass beneath the railway bridge, and the problem arose how to get by the obstacle. It was done in the following way:

Two scows were placed beneath one of the plate girders, and upon these was erected a platform, properly braced and trussed, to receive one section of the bridge. Two locomotive cranes were then run up, one on each side of the span, and the latter was lifted off its bearings on the pier Then the scows with their trucks were floated in beneath the span, and it was towed out of the way until the dredge had passed through. The span was then floated back into position; the two cranes lifted the bridge section from the scows, which were towed out of the way, and the span was then lowered to its footing on the piers.

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Floating out a span of the Gamboa bridge of the Panama Railroad to permit the passage of dredges up the Chagres River.

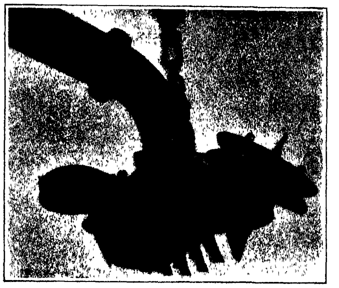
Ozonized Air

IN the *Journal of the American Medical Association* Drs. E. O Jordan and A. J. Carlson publish the results of investigations carried on under a grant from the *Journal* and relating to the bactericidal, physiologic and deodorizing action of ozone Their conclusions are a sweeping arraignment of the now rather widespread use of ozone as a gaseous disinfectant. The writers find that although some bacteria can undoubtedly be killed by ozone, this occurs only when the concentration of the ozone is so great as to be decidedly injurious to man "If disinfection of a closed room without inmates is desired, this can be much more effectively carried out by the use of formaldehyde or some other familiar gaseous disinfectant than by ozone. Ozone has no place in practical room disinfection." As to the weak concentrations of ozone actually used in ventilation, the writers incline to the opinion that, aside from possessing no sanitary value, such use is probably injurious in the long run, especially to persons with weak lungs. Ozone is not an actual "deodorizer" in concentrations that can be employed in practical ventilation. In very great concentrations it seems capable of oxidizing some odorous substances so that the odors are diminished or changed, but the result may be to make the odor actually more disagreeable. However, the deodorizing effect of highly concentrated ozone is due chiefly to the intense odor of the ozone itself, and possibly to the fatigue or anæsthesia it produces in the olfactory epithelium. As a rule such deodorizing is of doubtful utility, and the writers believe that ozone is being used as a means of bolstering up poor ventilating systems.

The Philippine Bureau of Forestry uses a launch for service between islands. The United States forest service employs several, both on inland lakes and in salt water, in Alaska and Florida.

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks



Side view of the drag, showing the cutting blades.

Modified type, showing the water jets.

Rear view, showing the scoop at the left lowered and that at the right folded up.

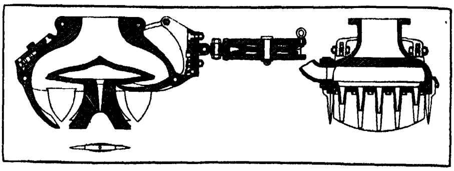
Automatic Drag for a River Dredge

THE ordinary river or pipeline dredge is anchored by a stud or large post which passes through a well in the hull and is driven into the river bottom. The stud then forms a pivot about which the bow of the dredge is swung by means of wire cables anchored at a considerable distance on each side of the bow. The bow of the dredge is swung from side to side in order to bring new sections of the river bed within reach of the suction pipe. The lower end of the suction pipe carries a revolving cage with cutting blades used to scrape and agitate the material that is to be dredged, so that it can be sucked up through the suction pipe. However, the agitating machinery of the suction pipe is somewhat complicated and requires a strong ladder for support and considerable power to drive it, to say nothing of the frequent and vexatious delays for repairs of the complicated mechanism. To overcome those difficulties, Gen. J. W. Sackett has devised a new form of river dredge combining many of the features of the hopper dredge which has a drag at the end of the suction pipe. Instead of moving the whole dredge about on a pivot, he provides for moving the suction pipe with a special form of drag at the lower end.

The form of the drag is shown in the accompanying illustration. It consists substantially of a rectangular bell mouth for the suction pipe; running fore and aft across the bell, is a hollow bar provided with bifurcated blades or teeth. Water is pumped down through a pipe into the hollow bar and issues in jets through openings between the prongs of the teeth. The water jets stir up the material through which the teeth are being dragged. In addition to these teeth, there are four cutting blades secured to the edge of the bell, which aid in confining the loosened material to the bell. In order to trap the material and make sure that it is all carried up the suction pipe, scoops are hinged at each side of the drag. The pulley blocks by which the drag is moved from one side to the other are attached to extensions of the scoops, and these extensions are in turn connected one to the other by means of links, so that when the drag is being pulled to one side the scoop on that side will be swung on its hinges to the folded position shown at the right hand side in the drawing, while the opposite scoop will be swung to open position, where it will be sure to trap the material scraped up by the cutting blades and teeth. When the drag is pulled to the opposite direction, the scoop on that side will hold and the other one will open.

This type of drag has been in use on the dredge "Florida" on the St. John's River for the past few months and has moved far more material per hour than the same dredge formerly pumped up with the standard type of agitating machinery. This dredge does not swing on spuds, as in the case of the usual type of hydraulic dredge. It has four spuds, two on each side of the center line. The port spuds are raised and lowered as the usual spuds. The starboard spuds are inclining, for which purpose the well through the hull is elongated fore and aft When it is desired to move the dredge ahead for another cut, the port spuds are raised, the stern paddle wheel is turned ahead, and the starboard spuds, with the points in the bottom, incline forward until an adjustable stop, abaft the spud at the top of the spud well on the lower deck, engages with the after side of the spud; thus regulating the distance moved ahead. The wheel is stopped and the port spuds are dropped; following which the starboard spuds are raised and assume a vertical position, when they are dropped and dredging is resumed. This operation consumes about forty seconds.

The suction pipe is pivoted on a swiveling elbow. The outboard portion is carried by a horizontal triangular frame, the apex of which is pivoted at the same place as the swiveling elbow. This framework projects over the bow, and the drag is raised and lowered by tackle suspended from a point slightly beyond the frame at the center of its outboard base. At each outboard angle of the frame, posts project downward, which are adjustable as to height and as to various angles with the vertical, and are secured in the position desired. Chains lead from each side of the drag to the foot of each of the posts mentioned and to a convenient place on the frame, where they are made fast. The frame carrying the suction pipe is swung back and forth across the bow of the dredge by means of a wire rope passing along a quadrant on the under side of the frame about midway of its length. By this means a cut 60 feet wide is made. A 10-foot section of hose is provided in the suction pipe of the dredge just beyond the bow of the dredge; which permits sufficient flexibility in the suction pipe to allow the outer end of the pipe to be raised and lowered within such limits as are desired. This apparatus, as arranged on the "Florida," permits dredging to a depth of 20 feet.



Arrangement of the scoop blades and teeth of the drag.

Suggestions for a New United States Patent Office Building

IN reply to a circular letter issued by Mr. E. W. Bradford, president of the Patent Law Association, Mr. G. D. Seymour of the Patent Bar made some very interesting suggestions which should certainly be given every consideration when the location, style and arrangement of the proposed new United States Patent Office Building is eventually decided upon.

Mr. Seymour believes that the building should be placed on Capitol Hill as near as may be to the Library of Congress, and that it should be designed in the Renaissance style and built of white or light colored granite. Thus the building would conform with the public architecture of Washington.

It is suggested that the building should be designed with particular reference to the collection and housing of a great working library, constituting a clearing house, so to speak, of information relating to the useful arts. This collection should contain, for instance, all American and foreign patents, technical works in the field of the useful arts, trade catalogues and all like printed material bearing upon patentable structures, processes, and products.

Mr Seymour believes that the building should also be designed to contain well equipped though not elaborate mechanical and chemical laboratories, where any experiments necessary to be performed in connection with the work of the examiners or tribunals of the office may be carried on.

The Drudgery of Farm Women

PRESIDENT COOK, of the Mississippi Normal College of Hattiesburg, Miss., contends that possibly nine tenths of the drudgery on the farm consists in carrying the water from the source of supply to the point of application and the disposition of the water after use." He points out that a bucket of water contains two gallons and will weigh 20 pounds, and when handled six times the total weight lifted is 120 pounds. He estimates that the use of water in cooking, bathing, scrubbing and weekly washing will raise the lift per day easily to a ton and that this will "take the elasticity out of a women's step, the bloom out of her cheek and the enjoyment out of her soul." He mentions that this daily lift can be eliminated "if the farmer can be brought to see that the farm is also the heir to modern invention," and suggests that an isolated farm can be supplied with a system of water works for an outlay of $250 and that these figures are for first class porcelain lined fixtures. There may be a field here for systematic inventive effort.

The Divining Rod

AT intervals, the divining rod appears in print with its various modifications, and reminds the writer of a story told by a Washington attorney about an applicant for a patent who attempted to demonstrate before the Patent Office Examiner the efficiency of his divining device in discovering gold. He said he was prepared to demonstrate the device, and the Patent Office official placed a small box in the middle of the room for him to sit on and told him he had concealed some gold coin, which he proceeded to "find," but with no success. Then the examiner told him there was a quantity of gold ore in the room, and the inventor, after several futile attempts, failed, and attributed the failure to his exhausted condition from traveling. The device, according to the inventor, indicated the gold ore as located at various points along the walls of the room and the examiner told him finally it was in the box on which he was sitting. The inventor appeared sincere in his efforts, but had evidently been carried away by his enthusiasm and did not again attempt to assert his claims.

Legal Notes

Some Patent Adjudications.—In Reece Folding Machine Company vs. Earl vs. Wilson, the Fenwick patent No. 606,528, for a machine for holding and pressing blanks for collars and cuffs has been held infringed on a motion for a preliminary injunction: the Dormandy patents No. 904,317 and 924,151, for machines for folding and compressing blanks for collars and cuffs has been held infringed on a motion for preliminary injunction and the Reece patent No. 972,916 for a machine folding and pressing blanks for collars and cuffs has been held infringed on a motion for preliminary injunction.

RECENTLY PATENTED INVENTIONS

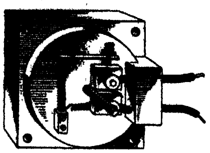
These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

DRESS SHIELD.—H. P. RINDSKOPF, 297 Summer Ave., Brooklyn, N. Y. This shield reinforces the seam or union of the sides of a shield and minimizes the cost of construction incident to the reinforcement. Its two sections are crescent-shaped, having a curved edge to fit under the armpit. The sides are preferably united at the arm seam by adhering the edges of the two sides at the point.

Electrical Devices.

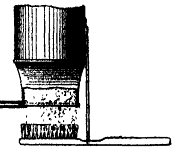
CIRCUIT BREAKER.—A. GUERRA, Celaya, Guanajuato, Mexico. This invention is directed more particularly to a thermo-electric apparatus, though generally relating to electric circuit breakers. It provides a thermally-controlled circuit breaker adapted to open a circuit under certain conditions of load. The apparatus is characterized by a movable element adapted to form part of the circuit, the said element being moved into position to open said circuit through the medium of an expansible rod, the expansibility of which is determined by the heating effect of the current.



CIRCUIT BREAKER.

Of General Interest.

TOOTH POWDER CONTAINER.—W. G. STEADMAN, JR., care of U. S. Navy Recruiting Sta., 161 Griswold St., Detroit, Mich. This invention provides a device for holding tooth powder with means for preventing the mouth of the container from engaging the wet brush, thereby obviating the danger of the power becoming caked around the exit opening in a manner common with the ordinary container. The container distributes the powder evenly on the brush, and means provide for securing economy in the use of the tooth powder



TOOTH POWDER CONTAINER.

Of Interest to Farmers.

BROODER.—J. A. CLARK, Bolckow, Mo. This invention comprises a combined brooder and coop construction which is so mounted as to be automatically actuated by the weight of the chicks it contains, to cause the same to close up and house and protect the chicks when a certain number of the young fowls have entered the same.

Of General Interest.

SURGICAL APPLIANCE.—M. IVERSEN, Stoughton, Wis. More particularly the invention is directed to an improved dropper, which is especially adapted for use in douching. The object of the inventor is the provision of a reversible dropper through which the fluid is adapted to be passed either in large quantities, as in giving enemas, or in certain determined quantities, as in protoclysis. In the use of this appliance there will be no effect of back-pressure on the dropper as the pressure will be the same on both sides; and there will be a free return for the gases and liquids in case of the patient pressing.

FILM PACK.—J. E. PETTIBONE, 4240 Flad Ave., St. Louis, Mo. In this pack the films are attached to a continuous strip so arranged that at no time during the manipulation of the films is there more than a single tab exposed, wherein the moving of each film from exposed position uncovers the succeeding film, the strip to which the films are attached being so folded that each fold when pulled straight, will move the film attached from the point to the rear.

FURNACE FOR TREATING ORES.—J. A. FREY, Silver Spring, Md. By means of this device ores such as those containing sulphur, arsenic, and the like may be treated in order to bring them into a state from which the valuable metals may be readily extracted. Steam is passed into the furnace under high temperature and pressure in order to aid in the treatment of the ores.

BINDING EYELETS.—W. R. INGHRAM, care of Mrs. Eva L. Inghram, 56 E. Wayne St., Waynesburg, Pa. This invention is for use in securing together in book form a series of periodicals, and has for its object the provision of means whereby the members of the series may be connected together in interlocking relation and in such manner that they may be opened in the same way as a book.

ADVERTISING MEDIUM.—G. T. FIELDING, 575 Fordham Road, Bronx, N. Y., N. Y. The intention here is to provide a medium more especially designed for use in show windows and the like, and arranged to effectively advertise a desired line of mechandise by attracting the attention of passersby for a considerable length of time.

VAULT DOOR.—G. W. KENNINGTON, 416 3rd Ave., Brooklyn, N. Y. In this patent the object is to provide a vault door, which is simple and cheap in construction, and which may be readily operated, the door being constructed in a manner that will leave it normally flush with the door frame.

GOGGLES.—L. D. CUTLER, P. O. Main St., Windsor Locks, Conn. In this invention a close fitting of the lenses to the face and especially at the nose is insured to prevent dust or other foreign matter from passing into the eyes of the wearer, and means provide for properly supporting the goggles at the nose without undue strain.

EVAPORATING APPARATUS.—D. COZZOLINO, P. O. Box 465, Escondido, Cal. This invention relates to apparatus for dealcoholizing, condensing, evaporating or distilling liquids, such as beer, ale, stout, malt extracts and the like, and semi-liquids, such as crushed fruit, jams, crushed vegetables and the like.

COMBINATION PIPE AND CIGAR HOLDER.—M. H. BARON, 147 W. Broadway, N. Y., N. Y. This invention provides a smoker's implement comprising a tobacco-holding member, a shield for the same, a mouthpiece associated with the member, and a deflector intermediate the member and the mouthpiece for deflecting the smoke on its way from the member and the mouthpiece.

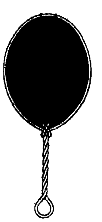
COMBINED CIGAR BOX AND HUMIDOR.—L. BRENAUER, 68 E. 104th St., Manhattan, N Y., N. Y. This invention is more particularly intended for embodiment in cigar boxes, although capable of use for other vendible goods or materials requiring to be kept in a moist condition. It provides an original package in which cigars and other goods may be vended, and having a self-contained humidor, including a removable element having an absorbent material

CORK RETAINER.—O. B. SCHELLBERG, 1058 Southern Boulevard, Bronx, N. Y, N. Y. This invention is characterized by the absence of sharp angles where the different portions adjoin, the structure being further characterised by a gradual curvature between portions extending angularly with respect to one another, whereby in the handling which the device must receive in use the tendency to damage is materially lessened.

COMBINED WORK BAG AND RETICULE.—HELEN H. TERRY, Southampton, N Y The invention refers more particularly to a device which comprises an outer bag or envelop having means whereby it can be closed, and an inner, foldable member having means for carrying different toilet or other articles, and adapted to be disposed within the outer envelop, or withdrawn therefrom to render the articles thereon available for use by nurses, maids and others while traveling, etc.

TRACE AND TUG BUCKLE.—N L ANDERSON, Box 886, Spearfish, S. D. This buckle is for use in engaging a trace and a hame tug. The invention provides a buckle of light construction and simple form, adapted to adjustably receive the trace therein and permit of the ready adjustment of the trace, to shorten or lengthen the same

FLY CATCHER.—MARY C. ARMSTRONG, 225 Kearny Ave, Perth Amboy. N J. Among the principal objects which the present invention has in view are: to provide means for holding adhesive paper or material in a manner to protect the same from accidental contacting with adjacent articles; and to provide a frame for supporting adhesive material or paper for disposing the same in convenient position and for otherwise handling the trap.



FLY CATCHER.

Hardware and Tools.

WATCHMAKER'S TWEEZERS.—H. E. HOLLOWAY, 149 Prospect St., Trenton, N. J. In carrying out this invention use is made of a pair of tweezers which have their clamping ends bifurcated, one side of which is so curved that when the bifurcated ends of the tweezers engage the overcoil end of the hairspring in the watch, they cause the end of the spring to bend in the desired direction while the main portion of the hairspring remains flat on the watch.

Machines and Mechanical Devices.

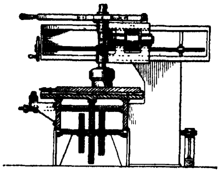
FRICTION CLUTCH—L. A PAGANI, 1031 Willon Ave., West Hoboken, N. J. This invention pertains to machine construction and has particular reference to clutches adapted for connecting one running part, for simultaneous operation, to another part. The object of the invention is to provide a friction clutch provided with novel means by adjusting the gripping shoes.

ARITHMETICAL ABACUS—J M. DE LA ROSA, Arequipa, Peru This invention relates to an arithmetical abacus or device for use in instructing any one, including deaf mutes, in the study of numerals, and it has for an object to provide an improved arrangement of mechanical members on which numerals, fractions, and other information are placed, the entire arrangement being such as to present various information in any desired order

CLUTCH MECHANISM—E. C WILLS, 116 E. Church St., Frederick, Md. This invention refers to clutch mechanisms adapted for general use and more particularly to clutch mechanism used in connection with shafting for the purpose of connecting shaft sections together, and then disconnecting them under such conditions that when connected they will have no slipping movement relatively to each other.

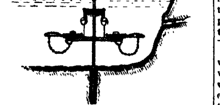
SAFETY ATTACHMENT FOR ELEVATORS.—H. J PIEPGRAS, Caldwell, Idaho. This invention comprises a safety attachment for stopping the elevator in case the load is not removed therefrom before the elevator platform reaches the highest point of its travel, and thus avoiding injury to persons or things on the platform and damage to the elevator parts.

MARBLE SURFACING MACHINE—C H JORDAN, 1015 Birch St., Richmond Hill, N Y., N. Y. This machine grinds the surface of marble or slate slabs down to a true surface and even thickness, and also countersinks to an even depth by means of a heavy iron disk with blocks of carborundum attached. It is also provided with an attachment that can be used for side cutting and molding The table has two speeds—slow for countersinking, cutting and molding, and faster for surfacing The grinding disk is first slid back clear of the table Thus unobstructed, the full size slab of marble or slate is placed on the table, the heavy iron grinding disk with the carborundum blocks is brought forward over the marble slab, the sleeve on the spindle is set and secured so as to grind down to the required depth, the disk rotating is moved back and forth at will and the table on which the slab is placed is moved back and forth in the opposite direction, thus grinding down the entire surface of the slab



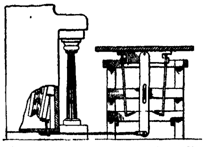
MARBLE SURFACING MACHINE.

STOOL FOR HOLDING TRAPS—W GREEN, Box 70, Holly, Mich This invention is an improvement in stools for holding traps especially for supporting the traps beneath the surface of the water, in position for catching muskrats and the like, and having mechanism for supporting bait in proximity to ordinary steel traps, and so arranged that the animal cannot obtain access to the bait, except by passing over the trap. When the animal scents the bait he tries to obtain the same, and will pass over the adjacent trap to reach the bait As he steps upon the bait pan, the trap will be sprung.



STOOL FOR HOLDING TRAPS.

BELLOWS ACTUATING MECHANISM FOR MUSICAL INSTRUMENTS.—J. P. RAWLS, 1715 Gervais St., Columbia, S. C. This invention relates to means for operating musical instruments, such as organs, player pianos and the like which include power bellows and is in the nature of a player's bench and certain novel connections with the instrument whereby the instrument bellows may be actuated by a minimum effort on the part of the player. It provides a highly efficient construction adapted to support the player of the instrument and to be actuated by a simple body movement of the player without necessitating pedaling of the feet, as is usual.

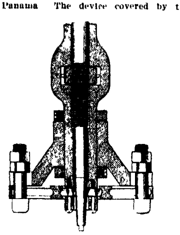


BELLOWS ACTUATING MECHANISM FOR MUSICAL INSTRUMENTS.

Prime Movers and Their Accessories.

HEATING COIL FOR CARBURETERS.—W. A. ERKENBRACK, Box 624, Webster, S D An object of the invention is to provide a coil which may be applied to any suitable carbureter for heating fluid fuel preparatory to its use The device is especially adapted to be used in cold weather when the difficulties of starting internal combustion engines increase in proportion to the decrease in temperature

JOINTING APPARATUS FOR BOILER TUBES—S A DUGAN, Gorgona Empire, Canal Zone, Panama The device covered by this patent is for jointing the tubes of steam boilers to the tube sheets The inventor produces an annular depression in the sheet to receive the tube, and he employs for the purpose a hollow shaft having radially movable cutters, which are gradually expanded by a tapered spindle, the spindle shank being threaded and receiving a nut fitting in a recess in the shaft



JOINTING APPARATUS FOR BOILER TUBES.

Pertaining to Vehicles.

AUTOMATIC PUMP—G J SPOHRER, care of Wilson Motor Starter Co, Franklin, Pa This invention more particularly pertains to a pump adapted to work with an internal combustion engine and more particularly adapted to supply compressed fluid to an automobile for the purpose of supplying energy to actuate an engine starter or to supply a source of power for any other purpose.

Designs.

DESIGN FOR A TOOTH BRUSH—C E. CARROLL, Newport, Ark In this ornamental design for a tooth brush Fig 1 shows a side view, Fig 2 an end view of the same

DESIGN FOR A CLOTHES LINE FASTENER—J MURPHY, 178 Hoyt Ave, Brooklyn, N Y *In this case Fig* 1 is a front view in perspective of a clothes line fastener, showing the new design; Fig 2 is a rear view, and Fig 3 is a cross section of Fig 2 indicating the surface configuration.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper

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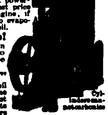
DETROIT ENGINE WORKS, 127 Bellevue Ave., Detroit, Mich.



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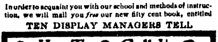

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An Electrical Automobile Transmission System

(*Concluded from page 78.*)

and constant torque on the propeller shaft is practically obtained.

Obviously, the functions carried out in driving the car can in a measure be reversed when the car is coasting with the engine running free. In this case the electric transmission then operates as an efficient brake in which there is nothing to wear. It will hold the speed of the car down to approximately 10 miles an hour on any grade where traction is obtainable.

The operation of starting the motor scarcely can require explanation. Current is drawn from the storage battery and passed to the field of the generator. Normally this would cause the armature to rotate and the car would be propelled backward. But when the brake is set, locking the propeller shaft, the field then rotates about the armature, and thus starts the engine. The electric motor serves a secondary purpose. When the car is driven on what corresponds to high gear, it furnishes current to maintain the battery in a charged condition, the current supplied being at the rate of about 10 amperes. When the car is standing, connections can be established with the control lever which will give a charging rate of up to 30 amperes, this rate being useful after the car has remained idle for a long time or for emergency

The system is not untried, for it has been in use in a car that has been driven for upward of 16,000 miles over roads good, bad and indifferent, practically all over the United States; incidentally, that its efficiency really is as stated is demonstrated by the fact that the gasoline consumption of the car was no higher than that of the ordinary car.

The Gyroscope in China

(*Concluded from page 85.*)

Fig. 4. Considering the motion about the axis *ce*, the motion of the particles in the quadrants are now shown by the position of the black beads, and we quickly arrive at the same conclusion; that the force *n* will develop a similar force *o*. A natural question at this point is: But since the shaft appears to move around in a horizontal circle, its rim does not move out as indicated in the different quadrants. How then can it develop the forces indicated? It is a good question. The answer is that the wheel rim does move out just as assumed. The proof may be had by making an enlarged photograph of the path of the free end of the shaft, and it will be found that it is made of a series of spiral loops If *a* represents the force of gravity, *o* will be equal to it in an opposite direction, thus preventing its falling; and the experimental proof of this is the fact that such a wheel does not fall, but moves off at right angles to the direction of this force, in the direction *n*.

This gyroscope *c*, Fig. 2, also serves to illustrate one aspect of the gyroscope as a compass If after it is spun up, the shaft is placed in a north and south position so that the large ball is pointing toward the north, and it be lifted up by means of the cord attached to the fulcrum at the center of the lever, it may be carried all about the room and swung round several times in each direction, and taken back to the stage, when it will be observed not to have departed from the north and south direction during its journey. This of course does not go into a deep explanation of how the centrifugal force due to the earth's rotation is made to act on a delicate gyroscope to cause it to take up a position so that its axis will be parallel to that of the earth, nor does it explain how the corrections are made due to the forces developed by the motion of the ship carrying it. But it does go a long way toward giving a popular audience an impression of its possibilities in that direction as in the compass so skillfully worked by Mr. E. S. Sperry in America and others in other parts of the world. (See Fig 2.)

Of very great interest also is the gyroscope shown at *D* in Fig. 2. This gyroscope has extended shafts on the horizontal side rings. It is first used without the stilts shown underneath it in the picture. The legs that are extended into sockets at the top of the stilts are sharp. When spun up it balances perfectly on these sharp legs. A weight is added to the cup shown at the side of the frame; instead of sinking down, the side where the weight is applied actually rises. This is due to the fact that in order to stand it must keep its center of gravity over the point of support. The only way to do this is by elevating the side upon which the weight is applied. In Mr. Brennan's monorail car, a large party may stand on one side, then rush in a mass to the other, resulting, not in depressing, but in raising the side to which they go.

This explains also why in rounding a curve the car tips up on the outer side in proportion to the speed and radius of the curve, so that to occupants it is as though the car were traveling in a straight line with the floor level. This is illustrated in this model by replacing the sharp legs by grooved wheels which are capable of running on a wire stretched in the air or laid on the floor as a track. This improvised monorail car will balance itself on such a wire even through a considerable weight is applied to one side or the other. The wire may be swung back and forth, but still it retains its balance without difficulty. After the experiments have been made in this way, the stilts as shown in Fig 2 are then added, and even though they are high in proportion to the size of the gyroscope it is able to stand up and even run on the wire when the grooved wheels are placed at the bottom of the stilts.

The rule above stated is capable of giving a very quick and practical solution of many gyroscope problems; for example, let us apply it to the case of the "wrestling" gyroscope, Fig. 5. This and several other pieces of apparatus used in this article were constructed by Mr. M. M. Wood of Berwin, Ill.

The wrestling gyroscope has been one of the very popular features of the gyroscope lectures in China. Its construction is readily understood by reference to Fig. 6. It consists of a strong bicycle wheel with the rim loaded with lead pipe and then wound with spring brass wire. When spun up to high speed and the case closed and set upon its edge, as shown in Fig. 5, it will stand up with a slight list to one side, and will precess slowly around on a nearly vertical axis. A member of the audience is invited to use a strong staff padded at one end with a solid rubber ball and make the wheel lie down on its side. (See cover illustration.) Any attack upon it above the middle develops a powerful and instantaneous reaction; and unbelievable as it may seem, it is nevertheless a fact that the strongest man is unable to push it over. This experiment delights the audience, and after two men have joined hands and been unable to push the gyroscope over, the audience is willing to accept the statement that a fairly light wheel running at a comparatively slow speed is able to develop a very heavy reaction. The audience then also readily comprehends how it may be possible for a wheel weighing tons and running thousands of revolutions per minute, to furnish a basis for stabilizing a monorail car or opposing the rocking of a ship.

Now how does the precession rule apply in such a case as the wrestling gyroscope shown in Fig. 5? It is seen that the case leans slightly toward and to the left of the reader. The force that is acting upon it is its own weight, which may be represented by a downward force from the ring represented by the arrow *a*. Now if the bottom of the wheel is traveling from the reader, the application of the rule (rotate the force *a* 90 degrees with the wheel) would result in the arrow *a* being rotated to point in the direction *n*. This would cause precession, due to the force *n*, and would result (by a second application of the rule) in the development of a force *o* which would counteract the gravity tendency at *a* and prevent the wheel's falling. Now suppose that a heavy external force is applied, as represented by the arrow *p*. The effect of this would be roughly speak-

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[illegible] shown in Figs. 3 and 4 with the accompanying explanation. The experimental proof is the fact that two men are unable to apply enough force at the point p to upset the wrestling gyroscope, which has a total weight of about thirty pounds.

It is always of great interest to the audience to see the experiment made in which, by applying the little finger to the wrestling gyroscope, it is controlled and made to lie down. A very slight pressure applied as shown by the arrow q, with the little finger, is sufficient to overcome the precessional force n due to the weight of the wheel, and it will slowly settle down to the floor in a direction opposite to that shown by the arrow q; for if q be replaced by the equivalent force r and the rule applied, it will show that r will result in a force downward coinciding with a and helping the gyroscope to come to the floor. This also is the explanation of how, by the use of a small lever, a large car like that constructed by Brennan is tipped down to the ground for convenience in loading on freight.

The Unsinkable Ship

(Concluded from page 86.)

6 inches high, increasing to 12 feet at the stem, and could be utilized to receive stores of all kinds, the compartments being only open at certain hours for issuing the day's supplies. The space from frame 254 aft, starting at 7 feet 6 inches and increasing to about 12 feet in height, could be divided into cold storage compartments for all the different kinds of provisions. The space amidships, 5 feet 6 inches high, would form the sub-basement for the hotel part of the ship above. All ventilating ducts, salt and fresh water mains and drainage pipes would be arranged in this space so that only vertical piping would be carried to the rooms. This grouping of all piping and ducts which run horizontally would save much trouble both in the design and working qualities of these systems. This I consider a very important feature in such a design. One of the hardest problems the designer has to face is dealing with pipes and ducts through living quarters, and it is always the horizontal pipes that give trouble. By having the main of these systems between the upper decks where they are accessible at all times without the passenger knowing anything about them, a continued source of dreaded trouble is removed and, furthermore, this would not interfere with the proper subdivision of the space.

Referring to the cross section through one of the boiler compartments, it will be observed that I have provided a longitudinal passage under the upper deck. This passage would be extended through each compartment, from which it would be entered through an air lock, and it would extend from frame 87 to frame 238. In each boiler compartment on each side would be the living quarters for all the men engaged in that compartment. These quarters would be artificially lighted and ventilated. The air would be taken from ducts between the upper decks on the inboard side, discharge at the floor line and would pass up through ventilating pipes on the outboard side. It might be objected that these quarters would be hot in spite of good ventilation. In this connection I consider it quite unnecessary to have much heat in the boiler rooms. The boilers in such a ship would be worked under forced combustion and in that case the fans for forced draught could draw the air from the outer casing round the smokestack and uptakes and discharge it into a casing outside the boiler lagging so arranged that the air would circulate round the boilers on its way to the tubular heaters in the uptakes. Thus any heat radiating through the lagging on the boilers would be taken up by the air for combustion, leaving the fire rooms comfortably cool, and with cold air freely circulated through the living quarters they should be quite comfortable.

The air lock doors into the central passage would be self-closing, balanced doors, easy enough for a man to open but certain to close after him, and it would hardly be possible to conceive of any damage to this passage even from a collision with a very large ship. At both ends of this passageway would be stairs in a water-tight well leading to the shelter deck.

Astronomical Bulls

IT is worth the trouble of studying astronomy just to be able to realize the delicious humor of the blunders committed by non-astronomical people, and especially the journalistic tribe, when they have occasion to discuss the heavenly bodies.

A fresh crop of astronomical bulls is given to the world in a recent number of *l'Astronomie*. After the partial eclipse of the moon of April 1st last, a French newspaper commented thus on the event:

"The phenomenon could be especially well observed because the moon was just at the full last night. What rare good luck for an eclipse!"

In 1911 Brooks's comet attracted more or less attention on the part of the newspapers. *La Presse* of September 28th, 1911, announced that the celestial wanderer "is now to be found in the constellation of Cygnus, three degrees north of Alpha, the upper star of the *Southern Cross*." Of course the cross in question was not the famous asterism of southern latitudes, but that formed by the principal stars of the Swan, lying along the Milky Way.

Of the same comet an Italian newspaper, *La Tribuna* (Rome), gravely stated that at five o'clock in the morning "its tail measures 20 meters long by about 8 meters broad at the end." We fear Mr. Kipling would not have agreed with these dimensions. One could not make much impression on a "ten-league canvas" with so small a brush. Nothing is more common than this habit, on the part of the laity, of estimating the apparent size of celestial objects in terms of a terrestrial scale. It would be extremely interesting to compare such estimates, e. g., of the *diameter of the moon—from* a number of the persons who appear to apply this method of measurement with such facility.

A Parisian newspaper recently undertook to compute the cost of a voyage to the moon, on the basis of current railway tariffs on our planet. The result was somewhat impaired by the fact that the writer confused the distance of the moon with that of the sun.

Why do artists persist in painting the new moon with its horns turned the wrong way? At last we have found a clew to this enigma. It is not merely a little joke on the part of the painters, comparable to the plumbers' time-honored prank of putting the hot-water handle on the cold-water faucet and *vice versa*. The moon represented in these productions is, it appears, not the astronomical moon at all, but the *lune de miel*—a body notoriously exempt from all natural laws. One sees at once the beautiful appropriateness of the fact that the walls of the marriage office at the *mairie* of the fifteenth arrondissement in Paris have just been embellished with a picture of this sort.

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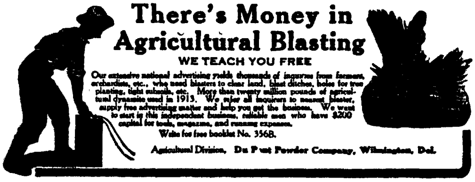

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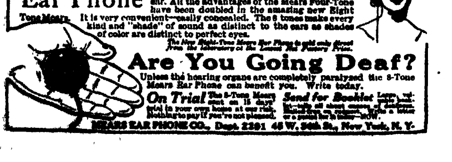

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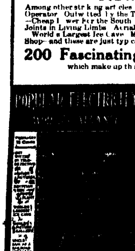

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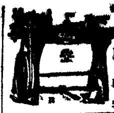
(12922) W. S. asks: Here on Gulf coast the sun rises on 31st June fully 25 degrees north of an east and west section line. Does the sun travel directly east and west on the tropic of Capricorn on the 31st of June? If so, the survey line is not right, for the tropic is south of us. A. The latitude of your place is not far from 30 deg. 15 min. north, and the tropic of Cancer, not Capricorn, where the sun is on June 21st, is in latitude 23 deg. 30 min. north. The sun, which is in the zenith of the tropic of Cancer at noon on June 21st, will be about 6 deg. 45 min. south of your zenith at noon on the same day. The sun rises in the east and sets in the west on March 21st and September 21st to all the world, and only on those days. From March 21st to September 21st it rises to the north of east and sets north of west, and from September 21st to March 21st it rises south of east and sets south of west over all the earth. At your place the sun never travels on an east and west circle through the day. It always moves obliquely up in the forenoon and down in the afternoon.

(12923) I. S. P. asks: Have you a SUPPLEMENT containing the formula for making electropoion fluid used in charging carbon batteries, consisting of sulphuric acid, potash, etc.? A. There are a great variety of electropoion fluids in which the same ingredients are used but in different proportions. A reliable mixture may be made of 40 parts water, 5 parts potassium bichromate and 10 parts sulphuric acid, all by weight. Dissolve the potassium bichromate in the water, heating it if necessary to produce solution, and add the sulphuric acid, pouring it into the solution slowly and with constant stirring. The same weight of chromic acid may be used in place of the potassium bichromate. We send you SUPPLEMENT 792, which contains full instructions for making a very serviceable battery to use with this fluid.

(12924) F. F. D. asks: How much horse-power approximately can be expected from a 40-inch Leffel vertical water power wheel with an abundance of water at 11½ feet head? Is that the kind of wheel to use with such a low head? Could a Francis tube wheel such as shown in your September 13th number be used to advantage? What is the advantage of draft tubes used below the turbine? How do you figure horse-power by the use of friction band (on line shaft pulley) attached to lever which in turn rests on a pair of scales? A. With a 12 inch intake you should develop from 18 to 20 horse-power with a 11½ foot head. With the use of draft tubes a Leffel turbine should be about as efficient as any other, although the writer would much prefer one of the Francis or Fourneyon type. The draft tubes below the turbines, by setting up a suction, convert the head in the outlet channels, which would be otherwise lost, into effective head which is added to the head above the turbine in the computations. The velocity of the pulley rim is measured by a counting apparatus. By the bolt *B* *v* can be made constant at any desired value. By reading the weight *G* on the scales the friction (*F*) becomes known as $Fa = Gb$. Then the work for any unit of time is $L = Fv$.

(12925) J. M. B. asks: Will you kindly state if there is a book published that will give a correct and up-to-date method of honing a razor? A. We do not know any book upon honing razors. Our Scientific American Cyclopedia, price $5, contains several modes of preparing razor paper strops, etc., which we can recommend as good. The only mode of honing a razor of which we ever heard is to lay the razor flat upon the hone and draw it along the hone, turning it over its back for the return stroke. It is usual to draw from heel to point as it is moved to and fro. 2. Is aluminium good? If so, what grade or kind of aluminium is best to use? A. We never heard of aluminium for honing razors. It is much softer than steel and so could not cut down the steel of a razor to a cutting edge. Hones are either oil or more often water stones of a very fine grit.

(12926) M. G. K. asks: If a bowl of water is placed upon a scale and the net weight is exactly 10 pounds (bowl about half full) and a live fish of about 1 pound is added to the bowl of water, is the weight of the bowl of water increased? I have heard that it is not with a live fish, but that it is with a dead one. A. The bowl, water and fish in your question weigh all together 11 pounds, and the scales will indicate that weight whether the fish be alive or dead, or whether a fish, a stone or even water be added to the amount of 1 pound. Probably the reason this question arises so often in the case of a live fish is that the fish does not touch the dish and seems to be borne up by the water. But the level of the water in the dish is raised and the effect is the same as if a pound of water were poured into the dish. If that was done no one would think that the weight on the scales would not be increased, why should they when the fish is added to the matter upon the scales? One pound of fish weighs the same as one pound of water, and affects scales to the same amount.



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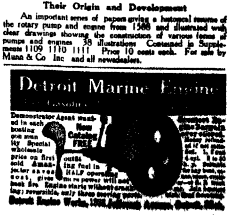

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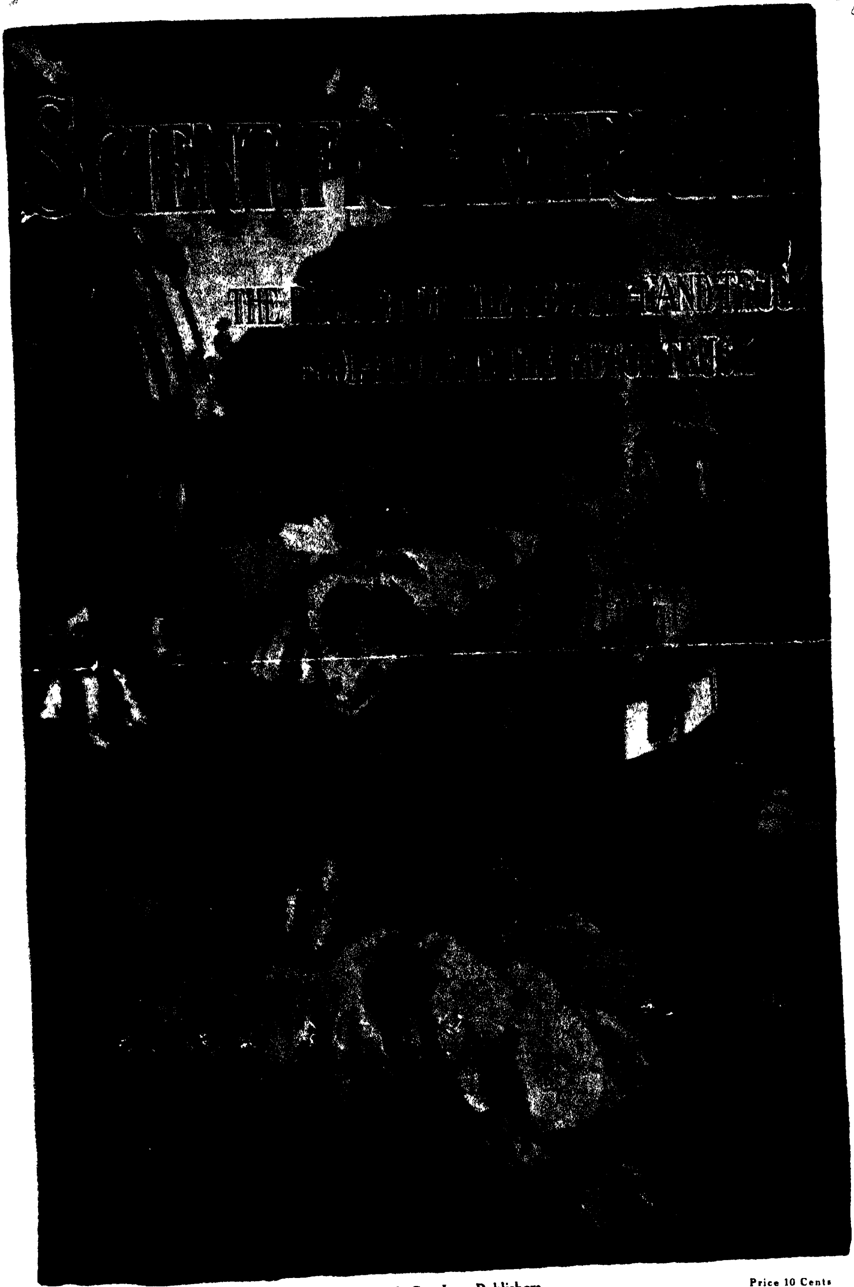

Vol. CX. No. 5
January 31, 1914

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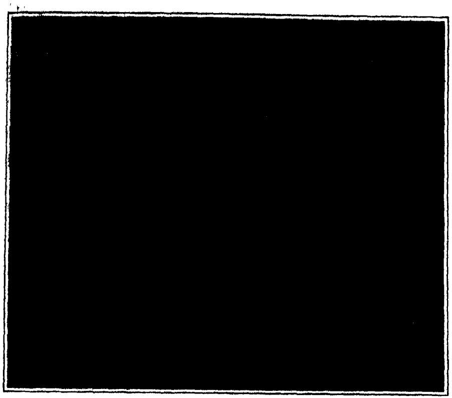
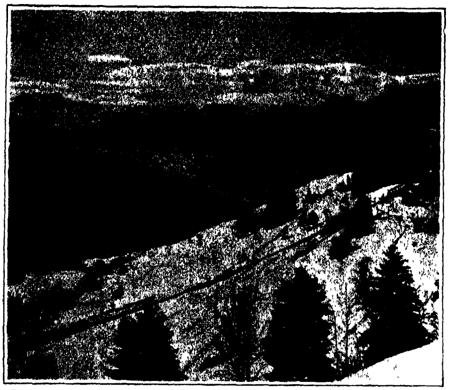
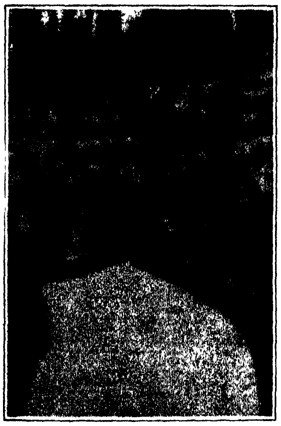


Loftily and picturesquely situated Engelberg in the winter season, showing the different runs and rinks.



The Funicular Railway between Les Avants and the Col de Sonloup. The Alps and the Lake of Geneva are seen in the background.



A double ski jump on the "Julier-Schanze" at St. Moritz.

The St. Moritz runs. On the left the Bob Run; on the right, the Cresta Run.

Taking a sharp corner in the Schatzalp-Davos Run.

Start of an enlivening ladies' ski Kjöring race at St. Moritz.

Winter Sports in Switzerland

WHILE Switzerland in summer is famous for her exquisite color combinations, Switzerland in winter charms as a dazzling vision in white. Ice and snow everywhere, glistening and sparkling. Never before has the sun been shining with more brilliancy, never before have the heavens shown a purer and deeper blue. The air is crisp and invigorating, and its effects upon the human body and mind are altogether marvelous.

It is for this reason that many prominent physicians have for the last fifty years been advocating the cause of winter in the Swiss highlands, and Prof. A. Nolda, M.D., a German authority on this subject, recommends it for a great variety of complaints.

The powerfully favorable influence on the nervous system, in cases of anemia, tuberculosis and chlorosis patients has constantly driven more and more neurotic patients to the high mountains. This influence was observed, not only by the doctors, but by the invalids themselves, especially after their return home.

Renewed health and buoyant spirits are the quick results of a sojourn in an Alpine winter station, and with them comes that natural desire to do something. The spirit of pastime is in the air, and very soon we find ourselves speeding down one of those invigorating runs.

Toboggans and bobsleighs of modern construction have ousted the old-fashioned herdsman's sleigh which is now used only by timid beginners. The up-to-date vehicle is the so-called skeleton which is made entirely of iron, weighing about 66 pounds, and on which the rider lies flat, with his head in front facing downward to the ground. For this purpose the iron ribs carry a cushioned board, which, in some types, is built so as to slide backward and forward. The question as to which is preferable, the fixed or sliding seat, is still undecided.

The exact guidance of the skeleton on a quick run requires a considerable amount of technical knowledge; as in simple tobogganing, there exist various guiding methods, which can be used and combined according to requirements. Of these the most important are, the pulling to either side of the front part of the toboggan with the hand and the pressing down the toes of the feet, which as a rule should not touch the ground. The tip of the boot must be protected by a "Bremseisen" (brake iron) a metal plate with sharp steel teeth which is buckled on each foot. The toes also act as brakes The skeleton is designed for great swiftness, but is not very suitable for the ordinary toboggan run. Hence in very many places there are specially prepared skeleton runs, on which the curves are extra highly banked. While the bobsleigh requires a run with a foundation of ice, or a hard frozen snow cover, the first class skeleton run, in order to attain the greatest speed, must be entirely iced.

The most famous skeleton run in the world is the Cresta run of St. Moritz. On the last third of this run, good riders attain a speed of 100 kilometers (62 miles), and more, an hour. Only experts are allowed on the Cresta run.

(*Concluded on page 106.*)

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

One-man Control of the Panama Canal

IT is announced from Washington that the President intends to appoint Col. George W. Goethals as the first governor of the Canal Zone. It is stated that an alternative arrangement was presented by the civilian commissioner at the Zone which contemplated a commission of three. Our President, as usual, has chosen the wiser course. The nation has had considerable experience with commissions at Panama. In the earlier phases of the work, they succeeded one another, after various degrees of failure, and it was only when one strong, capable and understanding man was placed in absolute control that order was brought out of chaos, and the great work of construction began to move with ever lengthening strides toward its ultimate completion.

The United States has learned several lessons from its Panama Canal experiences, and one of the most valuable of these is that among our many great national undertakings there will now and then arise one that calls for a single controlling hand, unhampered by the vagaries and futilities of a commission. It is very fitting, moreover, that the man who has been chiefly responsible for the success of the work should be its first governor. There can be no question that the appointment of Col. Goethals will meet with widespread national approval.

The Safety of Submarines

DEPLORABLE as is the loss of life, amounting in the past ten years to some 200 officers and men, which has occurred through accidents to submarines, we must not allow these disasters to shake our faith in the efficiency and safety of the modern up-to-date vessel of this type.

In the first place, it is significant that of the seventy-seven men that have been lost in the British service, the greater part have gone down in submarines of the earliest type built for that navy, and known as the A-1 class. So, also, the disasters in the French navy have generally happened to submarines of the earlier and more or less experimental types. That even these cruder vessels can be operated with safety is proved by the fact that we have in our own navy several submarines of practically the same design as those that have been lost in the British navy, and yet we have never lost a submarine, nor the life of a single man.

The submarines which have been built during the past four or five years, and those now under construction, are greatly superior to the first smaller vessels. As a matter of fact, among our own officers it is considered that no special risk attaches to submarine service. Our submarine flotillas come and go as they please, and do not hesitate to make extensive deep-sea voyages; as witness the recent 700-mile trip of several of these craft from Cuba to the Atlantic entrance of the Panama Canal.

An Ill-considered and Pernicious Bill

MEASURES of unbelievable inconsistency have occasionally been passed in the halls of Congress; but we doubt if those august chambers have ever witnessed such an act of stultification as was perpetrated by the recent passage in the Senate of what is known as the Seamen's Bill. We speak advisedly, for what other term than stultification can be applied to the action of the Senate when it deliberately passes a bill which is so drawn as to completely defeat the very object at which it aims? The bill in question is designated as "An act to promote the welfare of American seamen in the Merchant Marine of the United States; to abolish arrest and imprisonment as a penalty for desertion and secure the abrogation of treaty provisions in relation thereto; *and to promote safety at sea.*"

Surely it will be agreed that the last named object, "*safety at sea,*" *is far and* away the most important of those named in the bill. Everyone has a kindly feeling toward the men that "go down to the sea in ships;" and there is not a taxpayer in the United States who would not welcome with pleasure any legislation that would tend to make their lot easier and their daily life upon the sea more attractive. But when it is sought to do this at a sacrifice of those stringent safeguards of discipline upon which the security of the ships, of their cargoes, and, above all, of their passengers, depends, it is time to call a halt and subject such remedial measures to very close and critical examination.

It is not any desire to humiliate the seaman or exalt the position and prerogative of the officer that has evolved, in the course of centuries, the strict laws which now obtain in the merchant marine against insubordination or desertion; yet we are compelled to admit that a candid and impartial study of the wording of this act leads us to the conclusion, not only that it will fail to benefit the seaman, but that it will greatly impair the efficiency of the crews and most seriously interfere with the safe and efficient working of the ship. Should this act become a law, the only punishment for desertion will be forfeiture of the effects the seaman leaves on board and of such wages as are due him. For neglecting to join his vessel or to proceed to sea, for absence without leave within 24 hours of the vessel's sailing, or for absence at any time without leave, he is to be punished merely by forfeiture from his wages of not more than two days' pay. For quitting the vessel without leave before she is placed in security, he is to lose not more than one month's pay. For willful disobedience to any lawful command at sea, he may be placed in irons until such disobedience shall cease, and on arrival in port, he is to lose not more than four days' pay. And so the curtailment of discipline goes all through the bill, with the result that no penalty is provided for assaulting any of the officers except the captain or mate.

Another requirement is that the seaman is to be paid one half the wages due to him at every port where the vessel shall load, etc. To this it is objected by the owners that such procedure has a tendency to impair the efficiency of the seaman, who spends his money freely when he reaches shore, and that it thereby encourages him to desert and squander his earnings as fast as they accumulate.

The bill proposes to place in the hands of the crew alone the power to force at any time the creation of a commission from among the seamen to inquire into the condition of the ship. That this is unwise from the standpoint of safety is shown by the fact that such a complaint can be brought forward at any time and without any foundation, merely as gratification of personal spite or as a threat to secure the enforcement of demands. If any such stipulation is made, the commission should include at least one of the officers.

Another stipulation, to the effect that 75 per cent of the crew must be able to understand any order given by the officers, is aimed directly against the employment of Asiatic crews, and if it be enforced, it will drive the few American ships that are now plying on the Pacific coast out of business, and will discourage ships of foreign powers from visiting American ports.

The most impracticable clause of the bill, however, is that which in addition to calling for sufficient lifeboats (liferafts are not allowed) to accommodate every one on board, demands that there shall be two able seamen for every lifeboat, by "able seaman" meaning one who has seen three years on deck at sea or on the Great Lakes. This would mean the employment of a large number of deckhands who would be idle most of their time and would see practically no active service aboard ship, except in rare cases of emergency. How pernicious is this requirement will be seen, when it is understood that the firemen, stewards, storekeepers and other members of the crew, who form the greater part of the personnel on board a modern steamer, will be excluded by law from lifeboat service.

Could anything be more fatuous? As matters now stand, some of the finest boat crews are to be found among the firemen and stewards. Capt. Rostron, who was instrumental in rescuing the "Titanic" survivors, stated recently to a member of our editorial staff that it was not an uncommon thing for a boat manned by stewards to win in the boat-racing competitions, and that the stewards of a certain ship hold a silver cup won in competition against seamen.

There are many clauses in this bill with which we are heartily in sympathy, such for instance as those which provide for each member of the crew a certain amount of cubical space, a separate berth, and living accommodations that are properly lighted, heated and ventilated; those which provide for an adequate and specified supply of good food, and sufficient drinking and bathing water; but it is most sincerely to be hoped that the committee in the House of Representatives will so far amend this bill as to eliminate all those provisions which tend to relax discipline, encourage desertion, and place unnecessary burdens upon our already depleted and rapidly declining Merchant Marine.

Descents into the Crater of Vesuvius

PROF. MALLADRA of the Royal Vesuvian Observatory, whose first descent into the crater of Vesuvius was described in the SCIENTIFIC AMERICAN of June 15th, 1912, has since twice repeated his dangerous feat, viz., on September 9th and October 23rd, 1913. The former of the two recent descents, according to a note in the *Geographische Zeitschrift*, was made for the purpose of examining a new funnel-shaped vent, over 500 feet in diameter and 230 feet deep, which appeared in the floor of the crater on May 10th. Streams of gas flow from this vent, and since last July it has also glowed with incandescent lava.

Accompanied by Prof. Storts and Paul Jacobi of Munich, Malladra first descended the southeast wall of the main crater, a climb of an hour and a half. The floor, lying nearly a thousand feet below the rim of the crater, is a broad level surface, strewn with blocks of lava, and containing numerous fumaroles. The party then made the perilous descent into the new vent, where they remained for an hour, in spite of the terrific heat and stifling gases; taking photographs, making measurements, and collecting specimens of ejected material. An examination of the last showed that the volcano has entered a so-called "Hawaiian stage"; i. e., it is ejecting liquid lava of very high temperature. Attempts to measure the temperature of the lava with thermometric apparatus suspended by a wire rope failed, the thermometer and part of the rope being engulfed in the lava. The remnant of the rope was found to be strongly oxidized. In the fumaroles of the main crater temperatures of 380 deg. Cent. were measured. The whole time spent in the crater was 8 hours.

On December 21st, Mr. Frederick Burlingham, accompanied by two Italian assistants, descended into the crater and made a series of cinematograph pictures, which have since been exhibited in London. These include views of the crater floor, of the rim of the new vent, and, finally, remarkable pictures taken at the bottom of the vent, where the party remained for 20 minutes. The pool of boiling lava, known as "Hell Pit," was photographed at close range. Danger from falling rocks and poisonous fumes, as well as the intense heat both of the air and of the rocks over which the party had to climb, make this one of the notable feats in the history of moving picture photography, comparable to the cinematographic record of an ascent of the Matterhorn secured through Mr. Burlingham's efforts last year.

The Growth of the Lake Survey

THE Lake Survey is described at length in the last report of the Chief of Engineers, United States Army. As early as 1816 local surveys of the Great Lakes were made by engineer officers, but the "Lake Survey" (known officially as the Survey of the Northern and Northwestern Lakes) as a systematic work was inaugurated in 1841. The field work has continued ever since except during the years 1882-1889, while there has been no cessation at any time in the correction, printing, sale and issue of charts. The sundry civil act of March 4th, 1911, provided that the work of the survey be extended to include the lakes and other navigable waters embraced in the navigation system of the "New York canals," and the act of June 23rd, 1913, further extended the work to include Lake Champlain. During the seventy-two years of its existence the survey has cost the Government nearly $5,000,000. The water area charted is about 95,000 square miles, of which about two thirds is on the American side of the international boundary. The shore line amounts to 8,345 miles, of which about 4,700 miles is on the American side. These figures become more significant when it is added that the total shore line of the Atlantic, Pacific, and Gulf coasts of the United States, excluding Alaska and all islands, is only 5,705 miles. The fact that about 95 per cent of the commerce on the lakes is under the American flag explains the inclusion of Canadian waters and shores in the American survey. The present series of photo-lithographed charts in colors dates from 1895. In 1913 the charts in force numbered 120, and the total number of copies issued since the beginning of the work had reached nearly half a million. Prior to 1890 one full set of charts was issued free to each United States registered vessel, but since that time all charts have been sold at a price covering only the cost of paper and printing. Annual bulletins and supplements contain information too voluminous to be included on the charts. The main office of this important service, which is one of the striking examples of the many essentially humanitarian activities carried on by our War Department, is at Detroit.

Engineering

Naval Radio-Station in San Diego.—The board of naval officers which has been investigating the site for the location of a high-power radio-station on the California coast, has selected a site on La Chollas Heights, about four miles east of the city limits of San Diego, and eleven miles from the Pacific coast. It embraces some 74 acres which lie at an elevation of 450 feet above sea level.

To Prevent Settlement of St. Paul's Cathedral.—A Mr. Miller has submitted to *The Builder* a suggestion for preventing further settlement of St. Paul's Cathredal. He believes the settlement is due to the drying out of the subsoil, and he proposes to remedy this by sinking a cofferdam wall entirely around the cathedral to a sufficient depth, and then by means of perforated water piping giving the inclosed area sufficient saturation to bring it up to its original consistency and bearing power.

Naval Officers to Study at War College.—Henceforth naval officers are to be ordered to the War College for a course of twelve months study. This marks a new era in the administration of the college. Each new class will be associated with a class that has had six months' experience, thus handing down the spirit and traditions of the college from class to class. In our opinion, the instruction here received will exceed in importance that which these same officers received years ago at Annapolis.

One Million Dollars Saved on Projectiles.—There has been a remarkable drop in the prices asked for projectiles by the various American manufacturers. Thus, the Crucible Steel Company of America asks $378,000 for 1,200 fourteen-inch armor-piercing projectiles. Last year's price for an order of this kind would have been $600,000. For 2,400 fourteen-inch projectiles, the Bethlehem Steel Company has cut its price from $1,200,000 in 1912 to $768,000 in 1913. The total saving on this year's order for projectiles is over one million dollars.

Suggestion for Saving Submarines.—A correspondent has furnished us with a description of his plans for saving the crew of a submarine that has sunk. It consists of an annular tank carried in a depression around the hatch of the submarine, to which is connected a coil of air hose. The tank can be released from the inside of the submarine, when it will rise to the surface and provide a means of supplying air to the crew and even of forcing down sufficient air to expel the water in case of damage to the hull, thereby enabling the submarine to be floated to the surface.

The Toll of the Sea.—In spite of better construction, more accurate charts and the continued improvement of lighthouse service, the sea continues to take an enormous annual toll in property and lives of those that traverse its surface. The marine disasters of 1913 amounted in money value to $35,000,000 in British-insured ships and cargoes that were totally lost. On the Great Lakes alone, the storm of last November rolled up a loss of $4,700,000. The above figures do not include damages to ships and cargoes that were not total losses; for these, the damages amount to over $30,000,000.

Weight of Locomotive "Puffing Billy."—The Board of Education, South Kensington Museum, London, has kindly furnished the following additional particulars regarding the celebrated locomotive "Puffing Billy," whose centenary occurred last year. The weight of the engine in working order was 8 tons 6 hundredweight, and of the tender 4 tons 6 hundredweight, making a total weight of engine and tender in working order of 12 tons 12 hundredweight. At a speed of five miles an hour, "Puffing Billy" was able to haul about 50 tons, but on occasions as much as 70 tons was hauled at a reduced speed.

Emergency Rudder to Avoid Collision.—We have received from Mr. George E. Bell of Cambridge, Mass., a sketch of a design for rudders to be used in the event of a threatened collision. It consists of two rudders, attached one on each side of the ship just below the water line, which normally lie flush with the side of the ship, and are provided with operating mechanism controlled from the bridge, whereby one or other can be thrown out to produce a powerful turning effect upon the ship. The controlling gear is such that the rudder can be moved out gradually through its maximum arc of turning, and sudden violent wrenching effects upon the rudder or its attachments to the ship prevented.

Another "Tallest" Building.—Plans have recently been filed with the Bureau of Buildings, this city, for an office building which, on its completion, will be the tallest in the world, reaching a maximum height of 894 feet 6 inches. The structure is proposed to be built on the block bounded by Broadway, Eighth Avenue, 57th and 58th streets. It will be fifty-one stories high, with basement and sub-basement. The façade will be of brick and light stone, and the design will be ornamental, following broadly the Gothic style. The building is to be built by the Pan-American State Association and the tower is to be surmounted by an allegorical figure representing the Association. The estimated cost is $12,500,000.

Electricity

Low-priced Electric Automobile.—It has been reliably reported that Mr. Henry Ford, manufacturer of the well-known low-priced gasoline automobile, is soon to enter the electric field, producing an electric automobile that may sell as low as $600. According to the plans that have been given out, the car will weigh 1,100 pounds, of which 405 pounds will be taken up by the storage battery equipment. The storage battery will be of the Edison nickel-iron type and the machine will have a radius of 100 miles per charge.

Electric Operation of Turret Guns.—The recent announcement that the British dreadnought "Invincible" is to have its gun-controlling mechanism changed from electric to hydraulic gear has met with much criticism among electrical engineers in Great Britain. It is claimed that the change signifies no superiority of the hydraulic system, but is due chiefly to friction between two departments, one of which controls the guns and the other the electrical equipment. In our own navy, the guns are operated by electric motors under control of hydraulic variable speed gears.

Heating Churches by Electricity.—Electric power companies are constantly searching for outlets for their power during the off-peak load period. *The Electrical Review and Western Electrician* suggests that the heating of churches comes under this class. In some parts of Switzerland and in Germany, churches are electrically heated, and recently a church in Christiania, Norway, has been fitted with an electric heating system, current being supplied at the exceedingly low rate of 0.8 cent per kilowatt hour. In this country it would probably be impossible, and certainly unnecessary, to furnish the power at so low a rate. Nevertheless, current could be supplied to the churches with profit at far below the customary rate in order to raise the output of electricity during the off-peak hours.

The Electric Mail Wagons recently adopted by the Vienna postal authorities, says the *Electrician* (London), have been subjected to a test of 312,500 car miles, lasting over 15 months. At the conclusion of this test, 45 vans of 2½ tons capacity were placed in service. Lead batteries of 42 cells are used having a capacity of 300 ampere-hours at a 5-hour rate, and a maximum charging rate of 60 amperes. The weight of these batteries is 18 hundredweight, with a normal range of 35 kilometers (22 miles) fully loaded. The motors used have a maximum output of 15 horse-power, are series wound and are housed in the wheels. The garage is partitioned for each vehicle, and provided in its basement with charging equipment. For handling the batteries an elevator rises beneath the vans, so that the discharged batteries may be unshipped and replaced by fully charged ones. The weight of each van fully loaded is 6,300 kilogrammes (6½ tons).

John Walker Wilkins, a pioneer of telegraphy in England, and the first man in the world to transmit telegraphic signals through space, died at Kingston-on-Thames on December 18th last, at the age of 86. When Mr. Wilkins was only 18 years of age, he was appointed superintendent of the Northampton and Petersborough telegraphs. And a few months later, he became the general superintendent of the lines that had been extended from Hull to Fleetwood and from Rugby to Newcastle. It was at this time that he experimented with induction telegraphy and succeeded in sending messages from one wire to another 120 feet away. To be sure, his system had nothing to do with wireless telegraphy, as we now know it, in which Hertzian waves are employed. Nevertheless, it does mark the first attempt at space telegraphy. Unfortunately, Mr. Wilkins dropped his work in telegraphy shortly after visiting this country in 1851, and took up engineering work instead.

Automatic Isolated Lighting Plant.—A new automatic charging panel has recently been put upon the market for use with isolated storage battery plants. It is arranged to deliver the charge through the battery at a tapering rate, heavy at the start and gradually diminishing to a low rate at the finish, so as to avoid overheating, injurious gassing or spraying, and injury to the battery's plate. At the same time, a practically constant voltage is maintained on the external circuit during charging, so as not to disturb the lighting system. The entire operation is completely automatic, the gas engine stopping and disconnecting the dynamo and connecting the lamp circuit direct to the battery when the charge is completed. The only non-automatic feature, and this is intentionally retained, is that the system must be started by hand when it is time to re-charge, but warning of this time is given by a red lamp or an electric bell alarm. The reason the starting is not rendered automatic is because it is considered essential that the operator go in person to the plant and make sure that the engine is properly oiled and supplied with the requisite gasoline before it is started. To start the system, it is merely necessary to throw a switch when the battery current, acting upon the dynamo as a motor, cranks the engine until it runs of its own power.

Science

An Investigation of the Spanish Dialects of Mexico has been undertaken by Dr. Rudolf Wagner, who will also collect folklore from both the Indian and the Spanish-speaking populations of that country.

The Audubon Societies expended $80,000 in bird protection in this country last year. Junior Audubon classes, organized under the direction of the National Association of Audubon Societies, have attained a membership of 52,000.

Benjamin Osgood Peirce, Hollis Professor of Mathematics and Natural Philosophy in Harvard College, died recently in Cambridge, Mass. He was born at Beverly, Mass., February 11, 1854, and was a son of Benjamin Osgood Peirce. He received the degree of A. B. at Harvard in 1876; Ph.D. at the University of Leipzig. From 1879 to 1880 he was a student in Berlin. In 1881 he became instructor in mathematics; Assistant Professor of Mathematics and Physics, 1884 to 1888, when he became Hollis Professor at Harvard. Prof. Peirce was the author of "Theory of the Newtonian Potential Function," "Table of Integrals," and "Experiments in Magnetism."

The Big Game of British East Africa, outside of the three preserves of the colony, is rapidly vanishing, and, according to W. T. Hornaday, "is absolutely certain to disappear in about one fourth the time that it took South Africa to accomplish the same result." Hornaday points out that the present legal bag limit is ruinously extravagant; for $250 any man may buy the right to kill 300 head of hoofed and horned animals of 44 species, not counting carnivorous animals that may also be killed. Thus the richest big-game fauna of any one spot in the world, which nature has been several million years in developing and placing there, seems likely to be wiped out by man within the next fifteen years.

Medical Education in the United States.—In an interesting report on this subject by Dr. Graham Lusk, published in *Science*, it is stated that in spite of the campaign for higher standards waged by the Council on Medical Education of the American Medical Association and other agencies, there are still four States in which it is not necessary that an applicant for medical license be a graduate of a reputable medical college, while in the year 1912 the authorities of Tennessee presented the spectacle of licensing 175 persons who were not graduates of any medical school whatever. As to the medical schools themselves, however, it is gratifying to learn that quality has improved at the expense of quantity. The number of schools in this country has diminished from 166 to 110 since 1904.

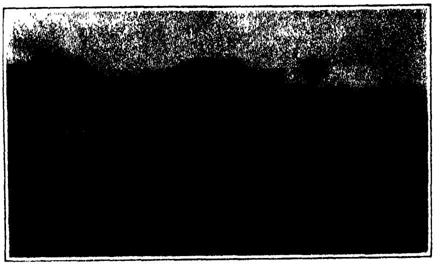
The Sea Route to Arctic Siberia.—The commercial possibilities of the route from Europe to the Arctic coast of Siberia *via* Kara Sea were again signally demonstrated last season, when the steamer "Correct," commanded by an Englishman, and having on board Dr. Fridtjof Nansen and two Russian officials, accomplished the voyage to the Yenisei and return, carrying profitable cargoes both ways. The voyage from Tromsö, Norway, to the Yenisei took 22 days, but the return between the same points was made in 10 days. A lecture on this voyage and the lessons it teaches will be delivered by Dr Nansen before the Imperial Russian Geographical Society, at St Petersburg. When it is remembered that the Yenisei River is one of the greatest natural highways of Asia (it is navigable for 1,840 miles from its mouth), and drains a region of immense mineral wealth, the importance of the fact that for about two months in the year navigation between its mouth and the ports of Europe is possible, will be evident.

The "Vinerie" System is one of several recent developments of wine-making described in a valuable paper by Messrs. F. de Castella and W. P. Wilkinson presented at the last meeting of the Australasian Association for the Advancement of Science. It consists in the sterilization of the grapes, as soon as they are vintaged and crushed, with a dose of sulphurous acid to render fermentation impossible. They can then be stored until such time as suits the wine-maker and fermented at leisure, after the removal of the sulphurous acid by the operation known as "desulphiting," under most suitable conditions as to temperature and cellar care. Thus wine-making is put on somewhat the same footing as brewing; i. e., the raw material may be harvested as rapidly as desired, but its transformation into wine is carried out as deliberately as the manufacture of beer. Evenness of type and reduction in the cost of handling are some of the advantages of this process. Desulphiting is performed in a column analogous to the rectifying column of a still, in which the bubbling of air through the liquid, under reduced pressure and at a temperature of about 70 deg. Cent. (158 deg. Fahr.) removes practically the whole of the sulphurous acid. Several important "vineries" have been established in Europe and Algeria, and it is expected that the use of the new process will be enormously extended within the next few years. One of its promising applications is in the manufacture of unfermented grape juice. The main credit for this innovation in wine-making is due to Barbet, the well-known authority on distillery equipment.

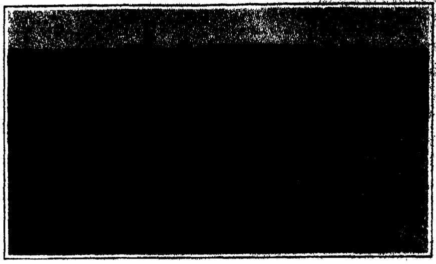
The Licorice Trade of Syria

The Curious Story of a Plant that is a Useless Weed in its Own Country and a Valuable Herb Abroad

By John D. Whiting



Factory and warehouse at Alexandretta where licorice root is pressed.



A great pile of licorice root at Aleppo.

WHERE and how is licorice obtained? What are the proportions of the trade that produces it?

A very considerable part of the licorice root used in America is from marshy plains in Turkey and Russia

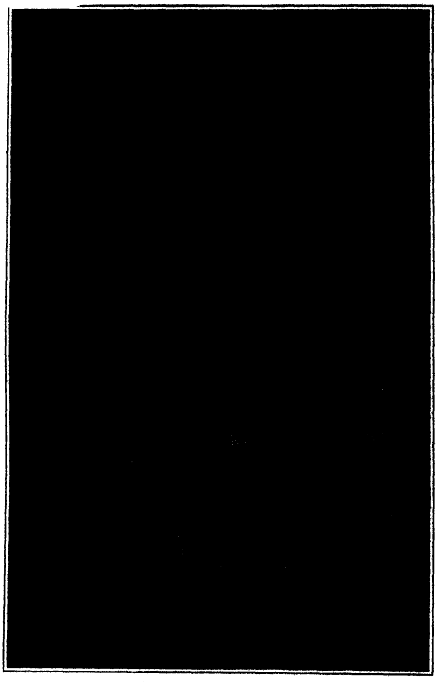
This root is not cultivated, but grows wild in large quantities, generally in great stretches of open ground where the soil is more or less damp It is regarded as a serious pest and greatly interferes with cultivation Much land is abandoned to it, while some is plowed and sown notwithstanding its presence. It is a perennial herb of the genus *Glycyrrhiza* of the bean family. The licorice of commerce is obtained by evaporating an infusion of the sliced roots This solidified substance is used for flavoring confectionery and beer as well as entering into the make-up of most of the brands of tobacco.

The growth above ground of the plant is about two feet, while the root is about as deep beneath the soil. The land in Syria from which the root is gathered is leased from the owners, the condition, as far as lands that are cultivated, being that the digging out of the licorice root must cease when the time comes for planting the cereal crops. The result is, as far as these lands are concerned, that the getting out of the roots must be done quickly as soon as the rains, which begin in October generally, have somewhat moistened the ground, as it would be very difficult to do the digging in the long dry summer

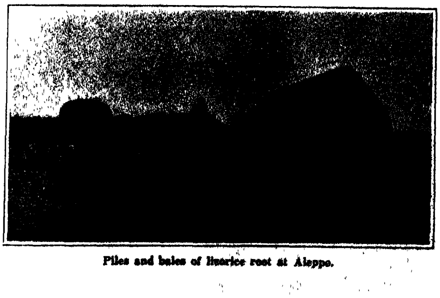
The collecting stations of Syria are at Antioch, Aleppo, Bagdad and Damascus. The company mentioned has other stations in the Smyrna district as well as in parts of Russia. Around the main stations are smaller depots located in the midst of the fields, each in charge of a man whose duty is to receive and guard the licorice as brought in by the natives These latter dig out the root with the primitive picks such as were doubtless used from the time of Abraham, and carry it on donkeys and otherwise as they can to the local station where it is weighed, as the payment is according to the quantity by weight, and they receive a receipt for the amount delivered. Traveling cashiers mounted on horses make the rounds of the depots, collecting and paying for the receipts

The root is piled in great stacks, and when the digging season is over a watchman takes charge, and the root remains thus stacked through the winter and the following summer, when it becomes quite dry and is ready for transportation to the coast. Great care has to be exercised that the stacks do not heat or mildew

One of the greatest questions involved is that of transportation. All the root from Aleppo and Antioch has to be carried to the seaport of Alexandretta. The largest contractors are Bedouin from near Hama. These receive large sums in advance to enable them to buy camels, and it is said by the members of the firm conducting the business, that these Bedouin are always faithful in carrying out their contracts. The root is packed into huge bags, two of which form a camel load. The transportation is also paid for by weight, and the weight is carefully checked when finally delivered. These Bedouin are found to be quite honest and faithfully deliver the quantity of root intrusted to them; but in their eyes the root is of little or no value, and they have no compunctions about making a little fire of the dry roots with which to bake a loaf of bread. This is the point that has to be guarded in the matter of weight.



Warehouse and hydraulic press for licorice root at Alexandretta.



Piles and bales of licorice root at Aleppo.

At the port of Alexandretta are several large presses which are located on the seashore.

Here, as our illustration shows, are seen immense stacks of the licorice. For shipment it is pressed into convenient sized bales by hydraulic presses, a couple of bands of strap iron being sufficient to hold one of the tightly compressed bales together. The bales are stored in large warehouses until shipped.

The Aleppo district gathers and exports on an average an aggregate of 8,000 tons annually of dry licorice root, while Bagdad yields about 6,000 tons, Antioch 4,000 tons, and Damascus 500 tons. All these stations are worked by the company itself except Damascus, whence it is supplied to them by native contractors. At Alexandretta one press is owned and operated by a native firm, but they sell their entire output on the ground to the American company mentioned.

At Smyrna a small quantity of the root is extracted for the European trade, and all the rest of this great annual harvest of root is shipped in a raw state to the United States.

This industry is a great blessing to this comparatively poor region, employing as it does many hundreds of natives and bringing cash into the country instead of taking it out, as so many foreign enterprises do.

The process by which the licorice is extracted from the root has already been spoken of, and it is interesting to add that after that is completed the pulp is pressed, with American ingenuity, into boards which are used in cabinet work and which are said to make up into novel and handsome articles.

Radiotelegraphy in Siberia.—The remote corners of the Russian Empire are rapidly being connected up with the world by wireless. During the year 1914 it is intended to install stations at Markovo, on the Anadyr River; Sredne-Kolymsk, on the Kolyma River; Tigil, Kamchatka; and Alexandrovsk, Sakhalin.

Foolproofing the Motor Truck

Eliminating the Personal Element in the Operation of the Commercial Vehicle

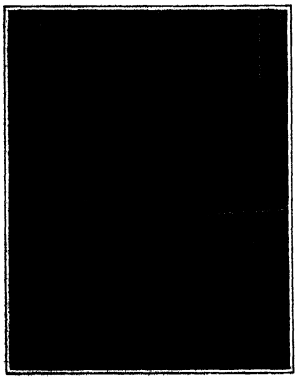
By S. H. Whiting

ALTHOUGH the motor truck has already reached the stage of perfection attained some time ago by the pleasure car, the designer of the former is confronted with far more serious problems than are to be found in the construction of automobiles of the runabout or touring type. The reason for this difference is not difficult to find. The business man purchasing a pleasure car looks upon his investment as more or less of a luxury and charges it to recreation and enjoyment. The motor truck, on the other hand, is purely a business proposition, and as such, must prove its ability to bring a greater return on the investment than can the horse system which it replaces. The result of this condition is that the pleasure car receives better care and is handled by more competent persons than is the truck. A $25 or $30 a week chauffeur is hired to drive and care for the pleasure car, or the owner gives it his personal attention. This salary for a truck driver, on the other hand, would be considered to be rank extravagance, and the tendency is to break in horse drivers as truck operators at a very slight increase in the $12 or $14 wages that they may have been receiving previously.

Naturally the truck manufacturers have had to consider these conditions, and the fact that the personal element has received deep thought is evidenced by the "foolproof" constructions and devices now found on many commercial vehicles. It is not to be expected that automatic steering and stopping devices will be installed, for every driver is supposed to possess the average amount of human intelligence, but the operation of interacting mechanical movements has been so designed that the manipulation of a lever at the improper time or in the wrong direction can do no more than to stall the motor. This effect, in part, is obtained by constructing shafts, joints, and bearings of sufficient strength to withstand any strain to which they can possibly be subjected, but this is supplemented by design of a finer order that materially reduces the probability of imparting such strains to the parts in question.

The design of clutches and transmission systems is illustrative of this point. Disk clutches or those of the cone type with cork inserts or small springs placed under the leather serve to prevent the sudden application of power to the rear driving mechanism—even though the driver's foot may slip from the clutch pedal or he may willfully release the pressure too quickly. The application of the load may be sufficiently sudden to stall the motor, but the owner may rest assured that there is no danger of a broken gear tooth or a sheared shaft key. The friction surfaces of the clutches, which are subjected to a greater amount of wear than any other portion of the car, are especially designed for such "punishment," and many instances can be cited in which trucks have been given hard usage for sixty and seventy thousand miles without the renewal of a clutch surface.

The planetary transmission has long been noted for its "foolproof" qualities, for the fact that all of the gears are in mesh all of the time precludes the possibility of stripped teeth when the change from one speed ratio to another is made suddenly without releasing the clutch. The limitations of the planetary transmission, however, to those of the two-speed type, has caused their gradual disappearance from use on heavy trucks, and to-day we find the three- and four-speed sliding gear transmissions occupying the center of the stage. These are of the same type as are used on pleasure cars, but their wide faces and general heavy construction make them better adapted to transmitting power to the greater loads at the rear wheels. While these gears are made of special steels and are subjected to special heat-treatment, all manufacturers do not think that this is sufficient protection against stripping or chipping when a careless or ignorant driver attempts to change speeds without first disengaging the clutch, and accordingly several devices to prevent this clashing of gears are in use on several makes of trucks. Probably the simplest of such devices is one in which the transmission lever is automatically locked whenever the clutch is engaged. The gears, therefore, cannot be shifted until the clutch pedal is depressed. This mechanism consists of a quadrant that is swung by the transmission lever. In the periphery of this quadrant are cut notches corresponding to the position of the transmission lever when set at the various speeds, and by means of a latch released by the clutch pedal when the latter is depressed, the transmission lever is locked except when conditions are proper for the gear change. Other "safety" systems consist of an individual disk clutch for each gear ratio, and the "dog clutch" and spring type. In the former, the gears are in mesh at all times, although they are mounted upon the main shaft and countershaft in the same manner as in the sliding gear transmission. It is the clutches that are operated to obtain the various gear ratios, however, and these are so arranged that but one can be engaged at a time. In the other type of transmission mentioned above, a small handle located under the steering wheel is used to apply spring tension to the gear that it is desired to shift, but by means of an ingenious arrangement of cams and dog clutches, this gear is prevented from moving until the clutch is released.



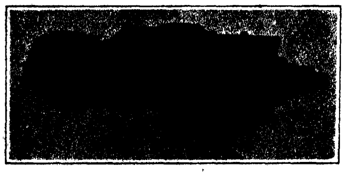
Spark lever inconveniently located to prevent tampering.

While these types of transmissions are not necessarily in general use, they are mentioned as examples of the thought that has been put upon "foolproof" design in order to eliminate, as far as possible, that uncertain personal equation that always enters into the success or failure of a motor truck installation.

But while considerable time and thought have been put upon the transmissions and "running gears" of trucks, the problem here is only one of mechanical strength. The motor, however, is susceptible to a variety of conditions that affect its efficiency, length of satisfactory service, and power output. It is well known by every motorist, for example, that to obtain the best results from his engine, the spark lever should not necessarily be operated *only* in conjunction with the throttle, but that the speed at which the engine is operating should have an important bearing on the time at which the spark should occur. But to obtain that proper position in which throttle opening and engine speed are taken into consideration, the driver must have had considerable experience, and must "know" his motor thoroughly. In fact, it is better that the spark should be left in a fixed position than that it should be unduly advanced at slow motor speeds or fully retarded at wide open throttle. Because of the difficulty of obtaining truck chauffeurs who will pay proper attention to these important details of motor operation, some of the truck companies produce machines on which no spark lever is provided, the contention being that if the spark is set to occur at the top of the stroke, no harm can be done, and the loss in efficiency that would be entailed at high speeds is negligible when compared with the damage that might ensue through improper operation of the spark.

On other trucks, the makers have not taken quite so radical a step, but have assumed that some sort of spark control is advisable. They have consequently located the spark control lever on the dash board where it may be reached if the driver leans forward, the theory being that, if it is not placed close at hand on the steering wheel, the spark will not be advanced or retarded unnecessarily. But this desire to remove the spark control lever from the possibility of interference by incompetent hands has resulted in the development of magnetos provided with automatic spark regulation in which the ignition in each cylinder is controlled to occur in accordance with the speed at which the engine is running.

It is generally admitted that the two conditions of operation which do more to injure a motor truck than any other practices are overloading and speeding. Unfortunately, no practical device has as yet been developed that will automatically prevent the former evil, but efficient governors have been devised that effectively regulate the speed of the motor. These are either of the centrifugal or hydraulic type, and generally operate on the throttle. They are so arranged that their operation or adjustment cannot be interfered with by an unprincipled driver without ruining the entire mechanism. Such a device not only controls the rate of travel of the truck, but regulates the speed of the engine and thus prevents that "racing" of the motor that is so conducive to wear and loose bearings, and yet that nevertheless seems to be the delight of many a so-called "expert" driver.



Gear ratios varied by means of clutches.

Because it is assumed that under certain conditions—such as when running under low gear, for instance—it is often advisable to increase the revolutions of the motor beyond the point at which the maximum speed on high gear would be obtained, some types of governors are placed on the transmission shaft. Such governors control only the speed of the car, but the owner of the vehicle may know that the speed at which his truck can carry its normal load efficiently, is not being exceeded by even the most careless driver.

Of course, on any mechanism subjected to the intense heat and great strains of the automobile motor, sufficient and efficient lubrication is of prime importance. An engine cannot run without fuel, but no harm to the machine itself will be incurred from a lack of gasoline. On the other hand, an engine can run for a short period without oil, but more harm may be done in this time than would result from thousands of miles of use under the proper conditions. And yet, for all its importance, the lubrication of the motor is almost the last point about which the motor truck driver need concern himself. With the unit power plants now coming into use, in which motor crank shaft and clutch—and sometimes the transmission, as well—are housed in the one aluminium crank case and extension, one lubricating system supplies the entire motor and allied parts. Oil in the proper amount is supplied to the necessary parts whenever the motor is run—and it is only necessary for the driver to fill the oil reservoir and gear cases at stated intervals. Points such as spring shackles,

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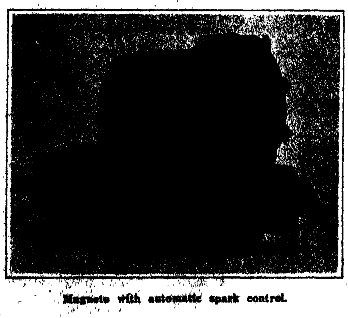


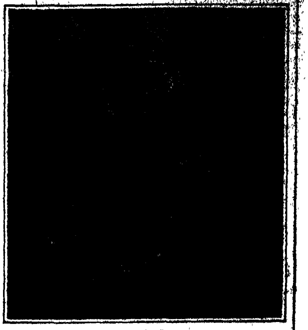
Magneto with automatic spark control.

Reassembling the motor.

The Problem of the Second-hand Motor Truck

How Used Machines Are Thoroughly Overhauled and Reconstructed in the Builders' Local Service Stations

By John S. Hardwhite



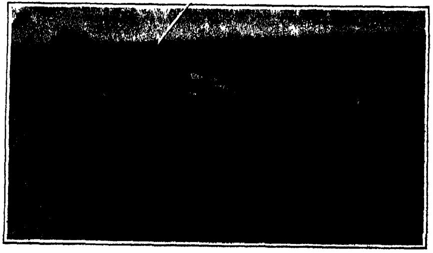
Testing the speed of the motor.

"SECOND-HAND" is a term carefully avoided by those concerns and individuals who make a business of buying and selling trucks or pleasure cars that probably have "seen better days." Whether it is thought that there is more or less ignominy attached to the purchase of a second-hand commercial vehicle that is now made in new models in such styles and at such prices as to fit the requirements and pocket book of practically every business man, or whether the term "second-hand" conveys the general meaning of "cast-off" or "discarded," matters not, but if the prospective purchaser of such a truck would be diplomatic, he should refer only to the "used" machine, or "rebuilt" truck.

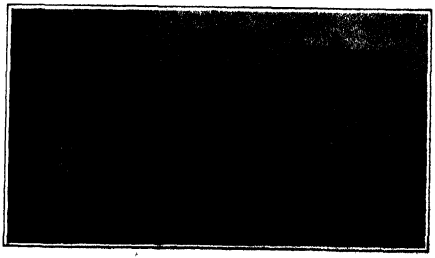
It is but natural that there should be a large number of such vehicles on the market; a man doing business in a small way may feel the need of a one-, three-, or five-ton truck, but may not have the ready cash to invest in such a machine when new; this demand is more than supplied by the number of trucks that are taken in exchange for new ones by the manufacturers, and by those that fall into the hands of the used car brokers But the pitfalls besetting the path of the unwary purchaser of a used machine are many, and the danger that the supposed bargain will become the most highly gilded of gold bricks is great. A famous name-plate may mean nothing on a second-hand car; the reputation of the manufacturer for high-class design and conscientious workmanship may count for naught; a used—or misused, rather—truck becomes a hybrid, an orphan, with no parent manufacturer to stand sponsor for it or for its performance. A truck possessing the reputation of using well-fitted and heavy bearings and of claiming more than its share of high-class and expensive steels may be absolutely ruined in a short time if it falls into the hands of an ignorant or careless driver or owner; while a truck boasting only a mediocre reputation when new, may, by proper handling and frequent inspection and repairs, be worth double the price of the first truck that had been so sadly misused.

Therefore it behooves the prospective purchaser who is a firm friend of a car or truck of a certain make to pick his way carefully before he decides on a second-hand machine of the same brand. To be sure, if the truck in question is sold by the "used car department" of its original manufacturer, and if, as is usual under such conditions, it has been carefully overhauled and rebuilt, and is sold with a six months' or a year's guarantee, it may prove a most excellent bargain and profitable investment. Many reliable manufacturers take used trucks of their own make in exchange, to apply as a partial payment on the sale of a new one, while others make a fairly liberal allowance for a truck of any brand. As chickens come home to roost, so do such trucks taken in exchange, eventually reach the parent factory in which they were born. There they again pass through the hands of their builders, are rejuvenated, as it were, and become safe and substantial investments for the man who is looking for a reliable truck at a lower price than the cost of a new one. A motor truck is an assemblage of hidden parts; the vitals of the machine are covered from the eye; several hours of expert dismounting may be required before the condition of an important bearing can be accurately determined; and the entire machine must be thoroughly overhauled before its actual value as a transportation vehicle can be ascertained. For the prospective owner to undertake this overhauling in order to determine the actual value of the truck, is impracticable; for him to employ an expert to undertake this work would prove prohibitively expensive. Therefore it is evident that his second-hand truck should be purchased only from an individual or company that is not only competent to overhaul and repair the vehicle, but whose word and guarantee are implicitly to be relied on. There are concerns doing a legitimate business in the rebuilding and sale of second-hand trucks, but their responsibility as to its performance replaces that of the original manufacturer, and their status should therefore be thoroughly investigated.

Dismantling the motor of a second-hand car.



Investigating the rear-end construction.



The chassis rebuilt and ready for service.

It may be argued by the man experienced in the *operation or management of* motor trucks, that he can determine by the action of the vehicle, by its "feel," and by the sound of the various parts, whether it is in proper running condition or not. Such a man, however, overconfident of his own ability in this line, is the one most susceptible to trickery. "Doctoring" a badly-worn motor truck is simpler and more deceptive in its results than is "doping" a race horse. By the use of preparations of heavy grease, badly-worn gears in the transmission case and differential may be made to run as silently—for a while—as the most perfectly cut bevels and spurs of a new pleasure car; poorly-fitting pistons and rings may be concealed and made to hold compression in the cylinders for as long a time as would be required by the ordinary demonstration; loose or even burned-out bearings may be temporarily repaired by means of makeshifts; slipping clutches may be made to grip, and leaking radiators plugged to hold water. Even defective rear axles may be repaired without being replaced, the necessary part being brazed or welded on. *All of* these repairs, being but makeshifts, are temporary—very much so, in fact—but all serve to make the machine appear to be in satisfactory condition for the first thirty miles or more. Instances could be cited, for example, in which a machine ran satisfactorily for several weeks after purchase, until one day a rear wheel calmly rolled off, and it was found that the rear axle had been broken months before and that a repair had been effected by attempting to weld the pieces and endeavoring to cover the poor appearance of the job with solder or white metal that would fill the crevices.

It is expected that every truck bought directly from an irresponsible individual or concern will be found to have been treated in this manner. Some trucks are sold with the frank understanding that no overhauling, inspection, or repairs whatsoever have been done. The condition of such trucks should be investigated carefully, but the purchaser or his agent has the advantage in this case of knowing that what trouble exists will probably be manifested immediately in the operation of the machine.

It is evident from the foregoing that the value of a second-hand truck lies in the reputation and reliability of the previous owner, rather than its former connection with a factory that may have stood for all that is best in truck construction. That there are "tricks in all trades" has never been better exemplified than in the case of the second-hand truck. However, it should be remembered that it is manifestly unfair to assume that there are "tricks in all trucks."

International Conference on Safety of Life at Sea

THE International Conference on Safety of Life at Sea, which has been meeting in London, has signed the seventy-four articles in the convention.

Its main points were summarised by Lord Mersey, chairman of the Conference, as follows:

"An international service is to be established by the nations chiefly interested for the purpose of an ice patrol and ice observation as well as the destruction of derelicts in the North Atlantic. It is to be under the control of the United States. This service is to take over and continue the work done by the two vessels employed by the United States in 1912-13 in locating ice, in determining its limits to the south, the east and the west, and in keeping in touch with it as it moves southward in order that vessels may be kept informed by wireless telegraphy on its position.

"The service will also continue the ice observation work started last year by Great Britain, with the object of determining before the ice becomes a peril the fundamental conditions which govern its movement.

"The service will also continue the duty of dealing with dangerous derelicts east of a line drawn from Cape Sable to latitude 34 north, longitude 70 west. The waters to the west of this line will continue to be watched by the United States.

"The duty is also imposed on all shipmasters to report the presence of dangerous ice and derelicts, and a code has been prepared to facilitate this reporting.

"When ice is reported on or near the track a ship must proceed during the night at moderate speed or alter its course so as to clear the danger zone.

"The practice by which routes across the Atlantic are fixed by agreement between the steamship companies has been left unaltered and the governments undertake to impress all shipowners with the desirability of following as far as possible these routes.

"The effective lighting of boat decks is provided for by the convention and the carrying of Morse lamps is made compulsory.

"An international code for urgent and important signals has been adopted.

"It was impossible to revise the international collision regulations, as many States which were parties to those regulations were not represented at the Conference, but the convention binds the contracting States to bring about a revision of these regulations.

"Other points affecting the safety of navigation were found impossible of embodiment in definite articles, but the committee submitted resolutions embodying its views.

"On the question of construction of passenger steamships the convention provides that the existing arrangements shall be considered on their merits by the country to which each vessel belongs, with the view of providing increased safety where practicable and reasonable.

"The most difficult point this committee had to deal with was the division of ships into watertight compartments. The convention provides that the degree of safety should increase in a regular and continuous manner with the length of vessels, and that vessels shall be as efficiently subdivided as possible, having regard to the services for which they are intended. It is also explicitly stated that the requirements imposed by the convention are minimum requirements."

Among the most important subjects dealt with under the heading of construction Lord Mersey mentioned bulkheads for the prevention of the spread of fire, means of escape from watertight compartments, requirements as to the strength of bulkheads and decks, the reduction to the smallest number practicable of the openings in water-tight bulkheads, the restriction of the number of openings in the ship's outer skin, appliances for closing the same; requirements as to the fitting and extent of double bottoms, the periodical operation and inspection of water-tight doors, etc.

Lord Mersey referred to the compulsory entering in logs of drills and inspections and the requirements by the convention of adequate backing power and auxiliary steering apparatus.

The committee, he said, had recognised the importance of making a further study of these subjects and of the exchange of information.

The full text of the convention will be published next month, when we shall publish a complete digest.

A Radium Motor

The Possibilities of Radium as a Motive Power of the Future

By Major H. Bannerman-Phillips

THE demand for a type of motive power for ships, vehicles and aircraft which can be generated by machinery working in a circumscribed space, and which does not require large stores of fuel to be carried, and a numerous staff of engine hands, stokers, etc., has led to the invention of oil engines and internal combustion motors in recent times. This demand seems likely to be redoubled in future, while at the same time the ever-increasing consumption of coal and the products of petroleum points to the ultimate, though not perhaps imminent exhaustion of our terrestrial supply. Under these circumstances it is natural that students of matter and the general properties of matter as affected by energy or force should be called in to co-operate with the engineer and the chemist in order that fresh sources of energy may be tapped and the powers of nature persuaded to work in harness for the benefit of posterity.

It may be that radium, that rare element whose properties are being slowly revealed to the wondering comprehension of the present generation, may prove to be a source of that motive power which is so urgently sought for, and in a lecture at the Cancer Hospital in London on December 10th last, Mr. C. E. S. Phillips (F.R.S. Edin.), who is honorary physicist to the Electrical and Radio-therapeutic Department of that beneficent institution, foreshadowed ideas in this connection which may bear fruit in time to come. He pointed out that radium in solution always decomposes water in which it is placed, giving rise to an explosive mixture of gases—oxygen and hydrogen; and he proceeded to illustrate the working possibilities of such a mixture with a small apparatus of primitive nature for the benefit of his audience. Owing to the scarcity of radium, he used on this occasion other means of producing the required explosive mixture, but the audience understood that it could have been produced by the action of radium as indicated. The apparatus consisted of a flywheel in the shape of a small paper windmill with the sails going round horizontally, instead of vertically. Close to this stood a glass tube shaped like the letter Y with a short length of electric wire inserted in each of the upper arms of the letter. This represented the combustion chamber of the embryo motor of the future. Fastened to the lower end of the Y tube was another tube running to a glass bottle containing the explosive mixture of oxygen and hydrogen referred to above and supposed to have been produced from the decomposition of water by radium solution. The lecturer turned a tap which let the mixture pass from the bottle through the tube to the Y-shaped "combustion chamber," and switched on an electric current, producing sparks in the upper arms of the Y. The sparks caused a continuous series of miniature explosions of the gas mixture, and the puffs of wind which resulted therefrom acted on the arms of the paper windmill and blew it round. It was a pretty experiment and may have more behind it. If the decomposition of water is all that is required to furnish gas for a new form of explosion motor, it seems hardly necessary to use radium solution for the purpose; there are other and cheaper methods of attaining the same end, and it is well not to count upon a supply of a commodity which is certainly unattainable at present. The enormous cost of even a minute quantity of radium at the present moment places it quite outside the pale of practical mechanics, and this is not surprising when one considers that it took M. and Madame Curie two years to produce one gramme of chloride of radium, and that they "worked over" eight tons of pitchblende in the process.

The Competition for the Michelin Prize

THE Michelin prize for the aviator who has flown the greatest total distance during the year, is arousing keen interest among French aviators. Thus far the pilot Fourny stands at the head of the competitors. In twenty-two consecutive days he covered the remarkable distance of 15,989 kilometers. This performance certainly speaks well for his Renault 70 horse-power motor. For eight hours a day during this period of twenty-two days the motor made 1,800 revolutions a minute.

New Motor Service for Siberia.—It is proposed to establish an automobile mail and passenger service between the cities of Verkneudinsk and Troitskosavsk in the Province of Transbaikalia in Siberia, shortly. The length of the proposed route is approximately 215 versts (142 miles) and if the undertaking becomes a fact, combined passenger and express motor cars will make the trip once a day in either direction. The fare per passenger has been tentatively set at from 21 to 22 rubles, about $12.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Highest Tree in the World

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of November 22nd, 1913, page 398, reference is made to the tall trees of Australia, implying that they exceeded the height of those found elsewhere. Having resided in Australia for ten years, and being fairly well acquainted with the trees there as also with the literature on the subject, it occurred to me that an explanation would not be out of place; hence, I am sending as an inclosure some extracts from Mr. Maiden's work, which is everywhere considered authoritative.

The Giant Trees of Australia.

The following is extracted from "The Forest Flora of New South Wales," by J. H. Maiden, Government botanist, page 162, in reply to the note which appeared in SCIENTIFIC AMERICAN for November 22nd, 1913, page 398, which reads as follows:

"It is claimed that some of the eucalyptus of Australia are taller than the California redwoods, which are commonly considered the highest trees in the world."

Visitors to the Melbourne International Exhibition of 1888 will remember the photographs of a large-butted gum-tree by Mr. N. J. Caire, photographer, who stated that he had come across this monster in Gippsland, and that its height was 464 feet. Here was something very definite to go upon. The trustees of the Public Library, Melbourne, voted £100, the trustees of the Exhibition Building another £100, the Minister for Lands promised a sum not exceeding £800, to have this leviathan measured and photographed. After some hesitancy on the part of the photographer, the identical tree photographed was found. The Inspector of Forests and a Government surveyor measured it accurately, and found it to be 219 feet 9 inches. Here was a come-down. "No tree in the neighborhood reached 300 feet." The Hon. James Monroe, premier of Victoria, thereupon offered a reward of £100 out of his own pocket for any Victorian tree 400 feet in height, *and the reward has remained unclaimed to this day.* Another man claimed to have found a tree there 525 feet high; but it turned out that the above mentioned tree was the one referred to. . . *Prof. Sargent is an eminent authority;* . . . and in view of the actual measurements that he presents, viz., 340 feet in height for a redwood and a girth around the trunk of 107 feet for its congener, the "Big Tree," I am of the opinion that, so far as our knowledge goes at present, California is the home both of the tallest and the broadest trees in the world. (1905.)

When the highest living Australian authority gives the banner to the United States, why should it not be accepted? FREDERIC W. GODING, *Consul General.*

Guayaquil, Ecuador.

Escape from Sunken Submarines

To the Editor of the SCIENTIFIC AMERICAN:

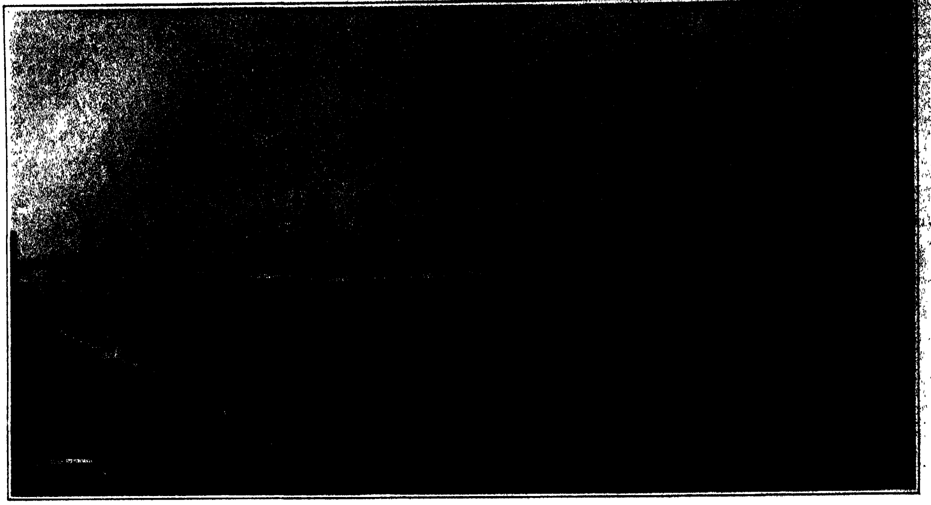
The inability to locate the British submarine A-7, which disappeared after a dive during the maneuvers on January 16th in Whitesand Bay on the shore of Plymouth Sound, and the consequent loss of at least eleven lives, suggests to the writer the desirability of installing on each submarine a device by which the location of a disabled and submerged boat might be readily ascertained.

It would appear to be an easy matter to construct a device similar in general shape to a torpedo, which, in case the submarine was unable to rise to the surface after diving, might be ejected from a torpedo tube. This device should be weighted in such a manner that on reaching the surface it would stand more or less upright in the water like a spar-buoy. At the top of this torpedo-buoy an oiled silk red flag might be attached in the day time, or a device for emitting a dense cloud of smoke, while at night a bright intermittent light might be displayed. To the lower end of the buoy a light cable would be attached, running back to the submerged submarine.

With such a device available it should be a simple matter, in case of accident, to discharge the torpedo-buoy, which on reaching the surface would present a readily noticeable mark to guide searching vessels to the location of the sunken boat. Once located, it would in many cases prove practicable, with the aid of divers, to attach cables to the ringbolts with which I believe all modern submarines are now supplied, and draw the submerged vessel to the surface or to shallow water, where the imprisoned crew could be released.

The writer does not profess to have kept in touch with recent inventions in connection with safety appliances on submarines, but has not seen a discussion of a device similar to that described.

Washington, D. C. HUGH A. BROWN.



These docks with their burdens are shown afloat in the river Elbe, Hamburg.

Steam and sailing ship repairs in floating docks I, II, and III.

The Most Modern Shipbuilding Plant in the World

Where the Two Largest Steamships in the World Are Under Construction

THE systematic and rapid manner in which Germany has built up her navy and mercantile marine is one of the most interesting developments of the modern industrial world. No nation, with the exception perhaps of the British, has understood so well the intimate relation which exists between a national navy and a national merchant marine; and the German government has seen to it that both have received the encouragement which is necessary to an adequate and relative development. The consequence is that Germany to-day not only possesses a powerful navy, replete in all its parts and most excellently administered, but it can lay its hand in case of war upon a vast fleet of mercantile cruisers and colliers (doing daily service in its merchant marine) which stands ready at a moment's call to proceed to its appointed rendezvous to be loaded with the coal, guns, ammunition, stores, etc., which are essential to turn it into a powerful and absolutely necessary adjunct of the fighting fleet.

We in the United States have neither the ships nor the policy—thanks to our fatuous neglect to build up an adequate merchant marine.

The encouragement afforded by the government, coupled with the far-sighted and courageous policy of the capitalist and shipbuilder, has led to the establishment in Germany of several great yards, all of which are capable of turning out warships and merchant steamers of any size, speed and capacity

It was our good fortune recently to visit the foremost of these yards—that of Blohm & Voss, which is situated on the river Elbe, opposite the city of Hamburg. This firm, the heads of which are Herman Blohm and Ernst Voss, was established in 1877 The plant which they have developed covers an area of about 460,000 square meters and has a water frontage of some 3,000 meters. The shipyard has its own harbor basin, which over a considerable portion of its area, is about 45 feet in depth The first object that strikes a visitor in approaching the yard by water is the towering superstructure of the building slips—a vast construction of steel columns and overhead girders suspended beneath which is a series of tracks, carrying traveling revolving cranes, capable of handling the heaviest pieces that enter into the construction of a modern warship or ocean liner. This structure is truly colossal in its proportions, and it was easily able to accommodate such ships as the "Vaterland," which is now completing alongside the wharf adjoining the building slip, and her sister ship, which is now in course of erection on the ways. These vessels are 940 feet in length over all, 100 feet in beam, and their height is over 100 feet from the keel plate to the roof of the topmost line of cabins. Despite this great height there is ample clearance between the bottom of the overhead cranes and the top of the ship's structure.

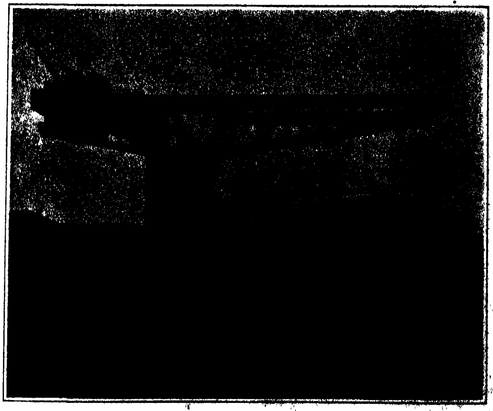
There are five older building slips located on the side of the works nearest the river Elbe, and in these ships up to six hundred feet in length can be built. The larger and more modern slips, above referred to, which face the shipyard basin, are employed in the construction of the battle-cruisers of which this firm has built so many, and merchant ships of the largest dimensions. These berths are served by no less than thirty-four cranes running on fourteen overhead tracks.

The sheets and structural shapes are heated and bent to form in extensive yards adjoining the slips, and here are found machine tools of the latest and most approved design, rolling mills, forging machines, giant shearing machines and planing and boring machines. High-speed cranes serve to transport the material rapidly from place to place.

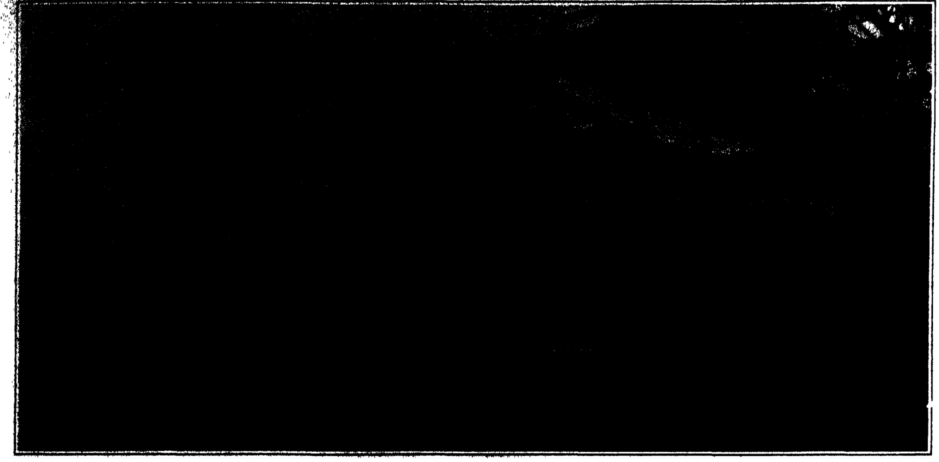
Two special shops are utilised for machining engine parts and assembling engines and turbines. One of these is devoted to reciprocating engines and auxiliary engines. The other is given up to the construction of turbines of the largest dimensions, such as those which have entered into the "Vaterland" and are being built for her sister ship. It is needless to say that special tools had to be built for handling and machining turbines of the great dimensions (they are 18 feet in diameter) of these turbines. The material is handled in these shops by high-speed electric cranes, which are specially designed for expeditious transfer from place to place. There are two separate boiler plants. The older one is devoted to the construction of cylindrical boilers such as are commonly to be found on merchant ships; the new boiler shop is given up to the building of water-tube boilers such as are usually installed on warships and high-speed passenger steamers. Special hydraulic and pneumatic machines have been designed for riveting, pressing and bending the steel sheets used in the boiler shops. Autogenous cutting and welding apparatus is extensively employed. Castings of bronze and steel are made in a special bronze and steel foundry.

Grouped around the larger shops are smaller but not less important plants, such as machine shops, carpenter shops, wood-drying and seasoning plants, a model-making shop, sawmills, paint shops and the usual auxiliary establishments of a great shipyard.

One of the most interesting objects in this yard is the huge 250-ton crane, which stands on the edge of the main basin. At present, this is the largest crane of its kind in the world. There are also a 150-ton crane, a 100-ton crane and one of



This crane, the largest of its kind in existence, can lift a load of 250 tons.



This ship, built for the Hamburg-American Line, is the largest in existence. As she went down the ways her weight was 31,000 tons, and the launch took place without a hitch She is 940 feet long, 100 feet beam, 73½ feet in plated depth, will weigh fully loaded 60,000 tons and will steam 28 knots. She differs from the "Imperator" in having a cruiser stern.

The launch of the "Vaterland" at the Blohm & Voss yard, Hamburg.

50 tons. For the transportation of material within the shipyard itself, a large number of traveling steam and electric cranes are employed. Material is extensively hauled by automobile trucks; and, of course, by locomotives running on tracks of both narrow and broad gage.

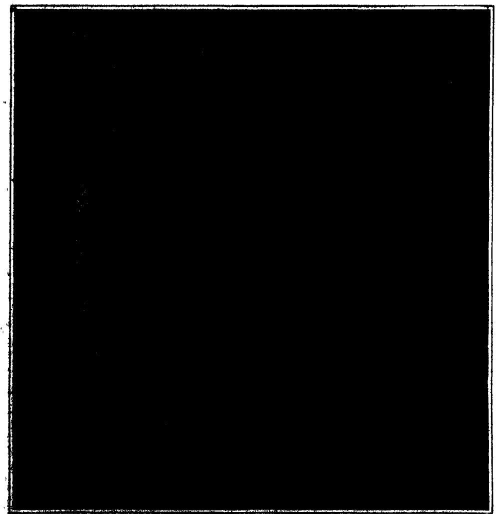
Power for operating the plant is generated in several large central stations in which reciprocating engines and turbines as well as air compressors and hydraulic pumps are installed. This energy is distributed by an extensive electric, hydraulic and pneumatic system over the entire yard. In addition to the power plants there are also gas plants for generating oxygen, hydrogen, acetylene and water gas. The oxygen, hydrogen and acetylene are employed in cutting and welding; the water gas is used chiefly for heating purposes.

The yard possesses a very fine laboratory and testing plant, both of which are equipped with modern instruments of precision for carrying out physical, microscopic and chemical investigations.

A characteristic feature of large German commercial establishments of this kind is the great attention which they pay to the design of their office buildings, which are often, as in this case, examples of very careful and highly artistic architectural planning and design. In the case of the Blohm & Voss yard, the technical and administrative staff is housed in a five-story structure of very appropriate design. The total number of officials and workmen employed at the present time is about 11,000.

As is well known, this yard has taken a prominent part in the building of war vessels for the imperial German navy; in fact, all the successful German turbine-driven battle-cruisers such as the "Von der Tann," "Moltke," "Goeben," and "Seydlitz" were built by Blohm & Voss; and they now have under construction a large battle-cruiser in which they are installing turbines of 100,000 horse-power, which are expected to give to the vessel a speed of 30 knots, if not more. In addition to the "Vaterland" and her sister, both of which are turbine-driven, the firm is building for the South American Line in the Hamburg-American Company, a triple-screw steamer which is driven by a combination of two reciprocating engines and one turbine. They are also building large docks for the Imperial German and the Imperial Austrian Navy.

A feature of the yard is the large dockage capacity, and especially the floating docks, the capacity of the five docks being 88,200 tons. This is the largest privately owned dockage in Germany, and the firm possesses the only floating dock capable of lifting the "Imperator."



Casing, 18 feet in diameter, of one of the low-pressure turbines of the "Imperator."

The Chestnut Blight

A PRELIMINARY report of the Pennsylvania Chestnut Tree Blight Commission now being distributed gives an interesting summary of the work done under its direction in the effort to combat and eradicate the destructive chestnut tree blight.

The introductory refers to the possibility of a serious timber famine confronting the American people, and the absolute necessity for concerted action of the friends of forestry and forest conservation to avert a threatened crisis. Attention is called to the fact that it costs fully one third more to-day to buy hemlock and other common varieties of building lumber than the same material would have cost only five years ago.

The chestnut blight occasioned a loss of many millions of dollars to the timber owners of Pennsylvania, and since the commission decided to discontinue its operations on account of not having received a sufficient appropriation, especial interest has been aroused, as the total extermination of our native chestnut is threatened. At least a dozen other States continue the warfare against the disease. The Bureau of Plant Industry of the United States Department of Agriculture, co-operated in a practical manner through a large pathological force. The main laboratories are at the University of Pennsylvania.

The reports of the several executive officers and others indicate very clearly that much progress has been made in the study of the proper treatment of infected chestnut trees. Especial attention was devoted to the utilization feature, and in this manner the owner of blighted timber was able to secure a ready market for its disposal at fair prices. The educational work enabled owners of trees to recognize the disease, and to obtain needful information of much value without cost, as to the treatment of diseased trees. The blight has been eradicated from the western part of the State, but spot infections will most likely reappear. Unless timber owners watch carefully, and destroy such infections promptly, the blight will spread rapidly and further heavy losses will inevitably follow. In eastern and southern Pennsylvania a large percentage of the chestnut was badly infected before the commission was created by legislative enactment.

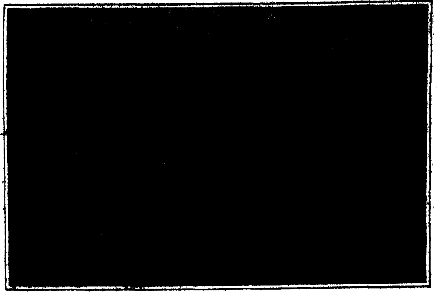
Recent cablegrams prove that the chestnut blight is prevalent in China, and therefore, probably of foreign origin Hence there is greater hope now that continued scientific research work such as is now in progress in this country, will reveal the much needed remedial measures to prevent the threatened total extermination of our native American chestnut trees.

The report contains seventy maps and engravings, and is worthy of careful preservation, as the literature upon this tree pest is limited, although the subject is an all important one from an economic standpoint. As a destructive parasitic fungus, the chestnut tree blight has done incalculable damage. It is a matter of deep and sincere regret and a direct loss to the State that no larger appropriation was granted by the Legislature.

A Good Grade of Excelsior is being made from fire-killed Alpine fir and Engelmann spruce in Colorado.

Automatically Reversed Trolley

AT the main station of the Pacific Electric Railway, from which all of the three-car interurban trains enter and leave Los Angeles, the danger to conductors as well as time lost in reversing the trolley has been done away with by an automatic system The grooves overhead in the station are arranged in a Y shape. The incoming car is reversed and this causes the trolley pole to run off laterally on one arm of the Y until it comes to the junction with the other arm. Then continued motion of the car drags the trolley back to the main line on the second arm of the Y. In this way the trolley is reversed without any delay; and as it is not necessary for the conductor to swing the pole around and walk across adjoining tracks in doing so, a common source of accident is eliminated.


System of overhead switches for automatically reversing a trolley pole.

Mail Carriers on Roller Skates

THE delivery of parcel post packages by United States mail carriers equipped with roller skates is the latest scheme devised to save time in this branch of the Government service. Incidentally, it also seems destined to cut quite a figure in the saving of shoe leather for post office employees.

The idea was originated by the foreman of the check room in the Chicago post office. In the basement of the building is a clear space of over 300 feet of smooth concrete flooring, on either side of which are arranged a total of 1,400 carriers' lockers. The checking of uniforms during the rush hours taxed the force of men in charge of this work to the limit Then the plan of providing the checkers with roller skates was hit upon, with the result that the time formerly required for carrying uniforms from one end of the locker room to the other was cut to one fourth. Following this the scheme was applied to the moving of packages of mail from one part of the building to another, and finally as a means for the regular delivery of parcel post packages on the outside.

The success of the experiment was such that Postmaster Campbell of Chicago predicts the plan will soon be generally adopted in all large cities in the country.

Roller skates save time and shoe leather in the Chicago post office.

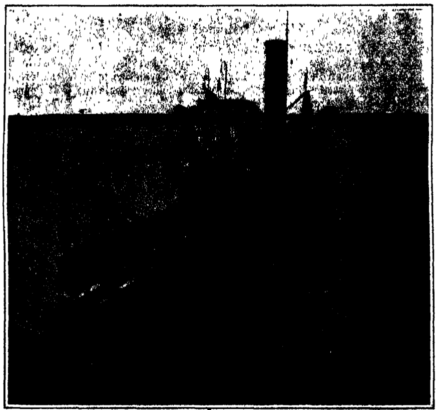
A Sea-going Dredge for China

IT would appear at first sight that in China manual labor for dredging work would be much cheaper than mechanical work, but, despite the fact that Chinese labor charges are five times lower than in Europe, mechanical appliances are proved to be much below the cost of manual labor. This difference is brought about not only by reason of the high power developed in a dredging plant, but also by reason of the fact that coal is 50 per cent cheaper in China than in Europe, and also the weather does not affect the general expenses with dredging machinery so much as human labor.

Pictured herewith is an interesting dredge recently built for the Hai-Ho Conservancy Board, Tientsin The dredge is of the barge-emptying and suction-loading type, and is capable of discharging the spoil into barges alongside, or through a floating pipe-line 1,000 feet in length, or through a shore delivery pipe-line over a distance of 9,800 feet.

The vessel is used as a suction dredge, either working at side anchors or in motion, and as a stationary pumping station for the discharge ashore of spoil out of barges. When pumping while in motion the dredger is arranged for discharge over either side into barges towed alongside, or through an opening in the bow, to which opening a floating pipe-line is fitted when dredging at side anchors. To balance the vessel the shore delivery pipe-line is fitted on the port side, while the barge suction is usually effected over the starboard side. The suction pipe for direct dredging at anchor is provided with a suction mouth, armed with a sleeve, so fitted as to avoid clogging when dredging a furrow 8 feet deep in easily collapsible earth. When the dredger is in motion the suction pipe is capable of reaching to a depth of 20 feet, and when dredging at anchor with a different suction mouth, of reaching to a depth of 25 feet. The normal service speed is approximately 8 knots.

When working as a pumping station, the dredge discharges the spoil through a 24 3/8-inch pipe-line, and delivers by means of its sand pumps 46 cubic yards of water per minute at 150 revolutions of the engine, while for the water pump the output is 47 yards with 160 revolutions of the engine. When dredging at anchor and discharging through a 1,000-foot floating pipe-line of 20-inch diameter, using one sand pump, the duty for the sand pump is 46 cubic yards per minute with 160 revolutions of the engine, while when dredging in motion and delivering into barges alongside, the output of the sand pump is 90 yards per minute at 150 revolutions of the engine.


Twin-screw barge emptying and suction loading dredge for China.

The Largest Flagpole

A CONSULAR report states that what is claimed to be the largest one-piece flagpole in the world is to be erected on the grounds of the provincial courthouse in Vancouver, British Columbia. The pole is a British Columbia fir, 205 feet in length, weighing approximately 5 tons after being dressed and allowed to season six or eight months. It will be set in a foundation of concrete 10 feet deep, giving it a height of 195 feet above the ground.

Electrification of Swiss Railways

A CONSULAR report states that Swiss federal engineers are watching with much interest the experiment of operating the Lötschberg Line by electricity, and that if it succeeds the St. Gothard will undoubtedly be equipped with the same motive power. In fact, the electrification of all Swiss railways seems to be the logical outcome of the fact that Switzerland produces no coal, but on the other hand is rich in water-power resources.

Steam Road Pavers

THE accompanying illustration shows a steam engine road paver at work on a long stretch of concrete extending out of Milwaukee.

Similar machines have been operating at Cleveland, Ohio, with a paving process consisting of a liquid asphalt combined with other ingredients which is mixed with sand and stone cold, and laid in this form.

This machine has a capacity of 20 cubic feet of loose material unmixed or 15 cubic feet of mixed concrete. The loading skip is 8 feet wide, permitting three wheelers to empty their barrows at once. The power plant is centrally located, the boiler being underslung. The loading skip has a very wide nose, so that it discharges into the mixing drum quickly and without any clogging tendency. The distributing spout is 15 feet long and is equipped with blades. As this distributor revolves it will of course continue mixing the batch right up to the point when it is discharged in the street. The equipment will handle three batches at the same time. While one batch is being loaded into the skip, another batch is being mixed in the drum and the third batch is being discharged from the distributor.

All levers are banked in one place, so that the engineer has absolute control of the machine, and can operate it himself. This machine is equipped with steering wheel, forward and reverse traction mechanism, compensating gears similar to those used in an automobile. As a two-bag machine the capacity has been greatly increased, the records made this season showing that it will easily average from 180 to 200 cubic yards of 6-inch base per hour.

It is said that the best record of a road paver of this type was 1,142 square yards of 5-inch base in less than 5 hours, at a cost of 3.7 cents per yard, with 23 men. Several other machines have nearly equaled this record.

Steam road paver used by the Milwaukee highway commissioners.

The Heavens in February

Uncertain Orbit of Delavan's Comet—Counting the Nebulæ

By Henry Norris Russell, Ph.D.

DELAVAN'S COMET, whose discovery was mentioned last month, is still under observation in the evening sky. It is however of about the eleventh magnitude, and is therefore visible only in telescopes larger than the average amateur possesses. Its orbit is still very uncertain; in fact, the results obtained by different computers differ radically, indicating that this again is probably one of the cases where two solutions of the problem are theoretically possible. That is, there might be two quite different orbits, so situated that a pair of comets, moving each in one of them, might be in line with the earth at the dates of all three observations, though before or after this interval of time they would appear to separate slowly from one another in the sky.

In such a case it may not be till some little time after the discovery of a comet that it can be distinguished with certainty in which of the two possible orbits it is actually moving, though ultimately this can always be done.

In the present instance, the preliminary orbits, computed from observations on three consecutive days, are described by the computers as "very uncertain." Messrs. Einarsson and Nicholson, at the University of California, deduce a highly inclined orbit, with the very small perihelion distance of one twentieth of the earth's distance from the Sun, and perihelion passage on June 28th, 1914. Kobold, on the other hand, finds the inclination small, the perihelion distance one ninth greater than that of the Earth, and the time of perihelion passage as March 2nd.

If the latter orbit is nearly correct, the comet should remain in the evening sky, and move northward and eastward, gradually growing brighter until the end of February, but probably not reaching the naked-eye limit.

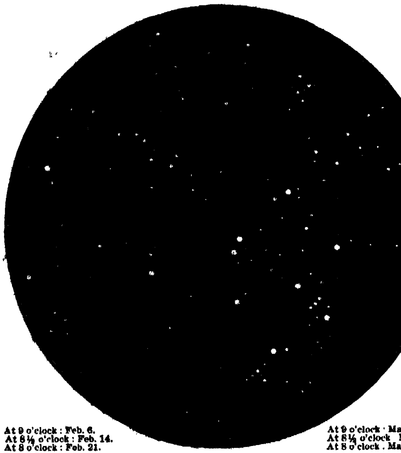
According to the ephemeris computed from this orbit, the comet should be in 3 hours 6 minutes right ascension, and 4½ degrees north declination on January 28th, the last date for which the calculations are made. Extending the ephemeris roughly, we find that on February 13th it should be in about 8 hours 35 minutes, plus 14 degrees, moving northeastward at an increasing rate.

If the alternative orbit is correct, the comet will increase enormously in brightness, and be a very conspicuous object next June; but until further and better computations are available, it is of no use to attempt to say more. We may console ourselves with the knowledge that, according to either orbit, the comet will continue to grow brighter until well into March, so that the fuller information which will no doubt be available next month will not come too late.

Of other astronomical publications which have recently come to hand, perhaps the most interesting is a paper by Prof. Fath, formerly on the staff of the Mount Wilson Observatory, upon the number of nebulæ shown upon photographs with the great 60-inch reflector. The plates upon which these nebulæ appear were taken in accordance with Prof. Kapteyn's "Plan of Selected Areas," in which certain regions of the sky uniformly distributed over the heavens and about 15 degrees apart, are photographed with long exposures, so that studies may be made of the positions, motions, brightness, color, etc., of the very faint stars (which are so numerous that it is hopeless to try so much as to count them over the whole area of the heavens). Upon the plates of 139 such regions (distributed from the North Pole to 15 degrees south declination) Prof. Fath has identified 167 previously known nebulæ and 864 new ones, most of which, of course, are small and faint. If these selected areas are typical of the whole sky, as there seems good reason to suppose, the whole number of nebulæ in the heavens, capable of being distinctly photographed with the 60-inch reflector, giving one hour's exposure on the fastest plates (Lumière Sigma), should be 162,000. Many of the larger of these nebulæ show distinctly the familiar spiral structure. The smaller ones are usually too small to show any such details; but on account of their usually elliptical form, Dr. Fath considers that a large proportion of them are also unsolved spirals.

The distribution of these nebulæ over the heavens follows the law, long known to be true, that they are *least* numerous in the Milky Way, and thickest strewn near its poles. In fact, on the diagram which Prof. Fath gives, showing the whole number of nebulæ (including his discoveries) photographed in each region, the Milky Way is immediately conspicuous as a broad blank belt. Most of the plates in the Milky Way show no nebulæ at all, some exhibit one or two; while the four regions nearest to the north galactic pole contain no less than 227 of them—nearly one quarter of the number found in the 139 regions photographed at Mount Wilson.

One of Prof. Fath's results shows that the number of nebulæ in the sky is not as great as had previously been supposed. The best previous estimate, based upon 104 plates taken at the Lick Observatory, had put the whole number of nebulæ in the sky at half a million—three times larger than the present figures. Though the exposures of the Lick plates were three hours long, Dr. Fath shows that the greater sensitiveness of present day plates, and certain other advantages of the Mount Wilson reflector, make it possible to photograph equally faint objects with the exposure of one hour which he used. Dr. Fath however clears up the difficulty by recalling that the Lick photographs were made primarily for the study of certain conspicuous nebulæ. The great number of faint nebulæ shown, in addition to the bright ones, on the resulting plates led to the estimate that there must be half a million in the whole sky. But these brighter nebulæ, like the fainter ones, are strongly clustered in some parts of the heavens, and hence the Lick photographs are mainly of regions which are much richer in nebulæ than the average of the sky. The Mount Wilson plates, being taken on a plan which was carefully designed to avoid giving an undue preference to any region of the sky above any other, are free from this tendency, and hence the number of nebulæ, estimated from them, is probably nearly correct.



At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

At 9 o'clock: Mar. 8.
At 8½ o'clock: Mar. 16.
At 8 o'clock: Mar. 23.

At 9½ o'clock: March 1.

NIGHT SKY: FEBRUARY AND MARCH

The Heavens.

As our map shows, the finest region of the sky is now in the southwest and west. The twin stars of Gemini burn near the zenith, attended by their fainter companions. Below them in the west shine the ruddy Aldebaran, the golden Saturn, and the brilliant and fiery Mars. Capella, with its lesser neighbors in Auriga, is high in the northwest, with Perseus and Andromeda below.

The incomparable Orion brightens the southwestern sky, followed by the noble outline of the Great Dog, whose minor stars seem fainter than they really are, since the surpassing brilliance of Sirius quite outshines them. Compared with these constellations, those of the eastern sky are dull. Leo, high up and almost due east, is the most prominent group. Below it is the greater part of Virgo, and to the right rises the huge length of Hydra, stretching from near the zenith to the horizon and below it.

Arcturus has just risen, a little north of east. Farther north and higher up is the Great Bear, now splendidly displayed. The Little Bear is on the right of the Pole, and Draco, Cepheus and Cassiopeia are low on the northern horizon.

The Planets.

Mercury is an evening star all through February, and is very well placed for observation. To be sure, he is almost at his nearest to the Sun, being in perihelion on the 21st, and at his greatest elongation, 18 degrees 8 minutes east of the Sun, on the following day, but this very nearness makes him exceptionally bright, while his favorable declination, about 8 degrees north of the Sun, keeps him in sight until 7·10 P. M., an hour and a half after sunset.

At this time he is in Pisces, not far from the vernal equinox, but remote from any bright star. Since he appears brighter than Saturn, and equal to Mars, there can be no possible difficulty in identifying him.

Venus is in superior conjunction with the Sun on the 11th. Theoretically, she is a morning star before this date, and an evening star afterward. Practically, she is invisible throughout the month.

Mars has passed opposition, and is receding from us and growing fainter; his apparent stellar magnitude changing from —0.6 to +0.01 during the month, corresponding to a loss of half his brightness.

He is nearly stationary in the western part of Gemini, moving westward at first, then retracing his path eastward, but a little more to the south. In the telescope, he shows a disk varying in diameter from 14 seconds on the 1st to 10.8 seconds on the 28th, and distinctly gibbous, like the Moon two days from the full. Jupiter is a morning star in Capricornus, and rises about 6 A. M. on the 15th, so that he is too near the Sun to be easily seen.

Saturn is in Taurus, conspicuously placed, setting a little after midnight on the 1st, and about 10 30 P M on the 28th.

Uranus is morning star in Capricornus, but is too near the Sun to be seen.

Neptune is in the western part of Gemini, his position being 7 hours 53 minutes 21 seconds + 20 degrees 27.0 minutes on the 2nd and 7 hours 50 minutes 58 seconds + 20 degrees 33.8 minutes on the 26th. He is of the eighth magnitude, and so can be seen even with a good field-glass, but he can only be distinguished from the faint stars all around him by the aid of his motion (making diagrams from night to night) unless a powerful telescope is available.

The Moon.

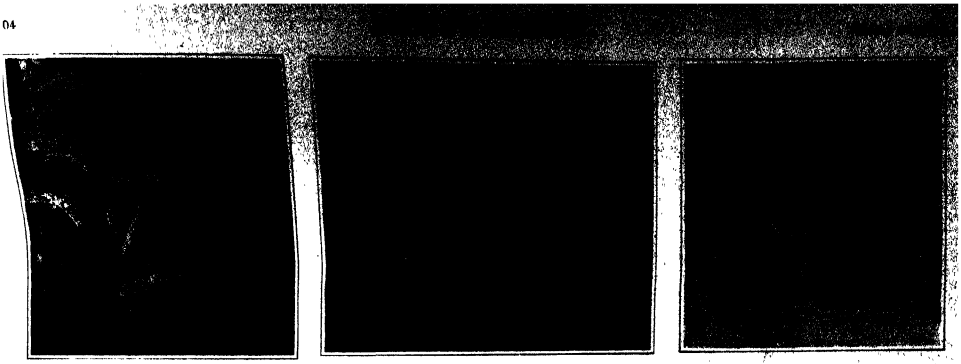
The Moon is in her first quarter at 6 A. M. on the 3rd, full at 1 P. M. on the 10th, in her last quarter at 4 A. M. on the 17th, and new at 7 P. M. on the 24th. She is nearest us on the 12th, and farthest away on the 28th.

She is in conjunction with Saturn on the 5th, Mars on the 7th, Neptune on the 8th, Jupiter and Uranus on the 22nd, Venus on the 25th, and Mercury on the 26th. In the case of Mars, an occultation is visible from certain parts of Asia, but not in our part of the world.

There is an annular eclipse of the Sun upon February 24th, but it is unlikely that it will be observed at all, unless from some ships at sea, for the region from which it may be seen lies entirely in the South Pacific and the Antarctic regions.

Princeton University Observatory.

To Stimulate Internal Combustion Turbine Development.—It is proposed that the Royal Automobile Club of Great Britain offer a suitable prize for the best practically useful rotary or turbine oil or spirit engine satisfactorily applied to a motor vehicle and entered for trial under R. A. C. regulations in 1915. It is believed that in so far as invention has progressed, sufficient inducement is offered for the expectation that inventive genius may solve this troublesome problem, and the prize will be offered as a stimulus. The amount of the prize has not been stated.



Three of the types of motor truck fenders that have been approved by the city of Detroit.

Fenders for Commercial Vehicles

THE question of the necessity for some sort of fender on commercial vehicles long has been pondered by municipal authorities in nearly every large city where the steadily increasing number of heavy self-propelled motor trucks serves always as more or less of a menace to life and limb and property. Not until now, however, has any concerted action seeking to a solution of the problem been taken. The city of Detroit, which is literally the hub of the American automobile universe, has taken the bull by the horns, so to speak, and has made it compulsory upon the owners and operators of commercial vehicles to equip them with fenders, as, a long time since, the traction companies were compelled to equip their rolling stock with them. The action of Detroit in thus compelling the use of such devices is taken as but a prelude to similar action on the part of Chicago police authorities and those of other large cities in the United States, and, incidentally, it opens up a large field for inventors of contrivances of the like. Three of the types of fenders that have been formally approved by the Detroit authorities are illustrated herewith, though the pictures scarcely can be taken as an indication of exactly what the police department wants, for it has given no inkling nor idea nor specifications of its particular desires It is stated only that the lower bar of the fender submitted for approval must be not more than six inches from the roadway when the truck is being operated either light or loaded on the city streets.

Motor Truck for Mine Rescue Work

THE recurrence of mine disasters, revealing as it does the almost pitiable equipment that is available for the relief of entombed miners, has served to emphasize the need of modern apparatus and appliances with which to carry on rescue work, and acting upon the suggestion conveyed by the successful use of commercial motor vehicles in other fields, the Bureau of Mines of the Department of the Interior at length has developed a plan which revolves chiefly around the use of a new and special type of vehicle thoroughly and properly equipped for the purpose.

The vehicle itself, which already has been delivered to the Bureau of Mines in Pittsburgh, is illustrated herewith and from the picture some idea of the completeness of its equipment may be gained. Instant access to everything the truck carries for rescue or hospital work is absolutely essential, of course, and for this reason the body, except for the space occupied by the crew, is virtually a series of lockers and compartments and the interesting feature of them is that in nearly every case they open from the outside and are held closed only by snatch hooks

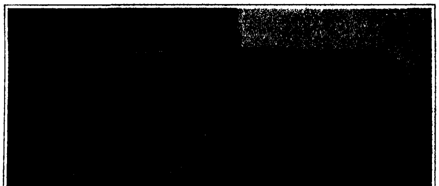
The equipment of the truck is most complete; the devices it carries form an uncommonly long list, including even the caged canary that has proved so useful in determining the existence of poisonous gases. By way of emphasizing the great amount of apparatus that is carried it is interesting to note that there are included no less than ten complete resuscitating outfits. The oxygen tanks, of which there are six, are carried beneath the body on a sub-frame and are so placed that they can be drawn forth from outside the truck. The oxygen pump is operated by the truck engine and is mounted at the left side of the chassis. Directly behind the driver's seat there is a series of compartments containing a tent, 22 feet of hose, three miner's picks, three shovels, a four-pound sledge hammer and two axes. The seats for the crew are behind these compartments and beneath them there is more storage space with another large locker, made up of a series of shallow drawers below the steps at the rear. These drawers serve to hold saws, hose couplings, reducers, spanners and 200 feet of half-inch rope.

In the central compartments along the body there is a life line reel, a complete telephone system for mine communication, and a various assortment of necessaries such as compasses, tools, and snatch blocks and tackle. Stretchers and fire extinguishers are disposed on the outside of the body by means of special hooks. On the running boards there are two more large boxes which are used to house mine lanterns and other miscellaneous equipment. Completing the equipment there is an eight-inch swivel headlamp mounted on the dash.

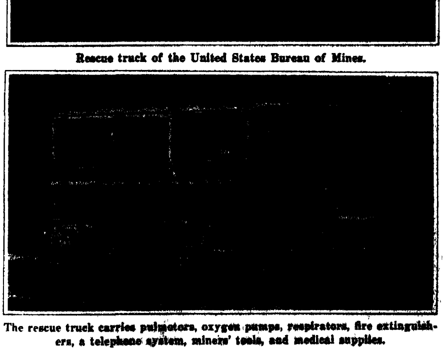
Motor Truck "Emergency Wagon"

EMULATING the practice of street railroads and gas and electric light companies that must of necessity be ready for all kinds of emergencies, a prominent commercial vehicle manufacturer has prepared and placed in service the emergency wagon that is shown by the accompanying illustration. The wagon is a light commercial vehicle chassis upon which there has been placed a special body equipped with tools, spare parts, and, in fact, everything that may be necessary to succor a crippled car on the road; the equipment is complete even to an extra pair of wheels which may be seen carried at the back of the body. In the picture, the emergency wagon is shown towing a disabled car which is a little the worse for an encounter with a trolley car. The front of the touring car rests on an extension on the emergency wagon, as may be seen, and when this extension is not in use it folds up out of the way.

Emergency truck towing a machine damaged in a trolley car collision.



Rescue truck of the United States Bureau of Mines.



The rescue truck carries pulmotors, oxygen pumps, respirators, fire extinguishers, a telephone system, miners' tools, and medical supplies.

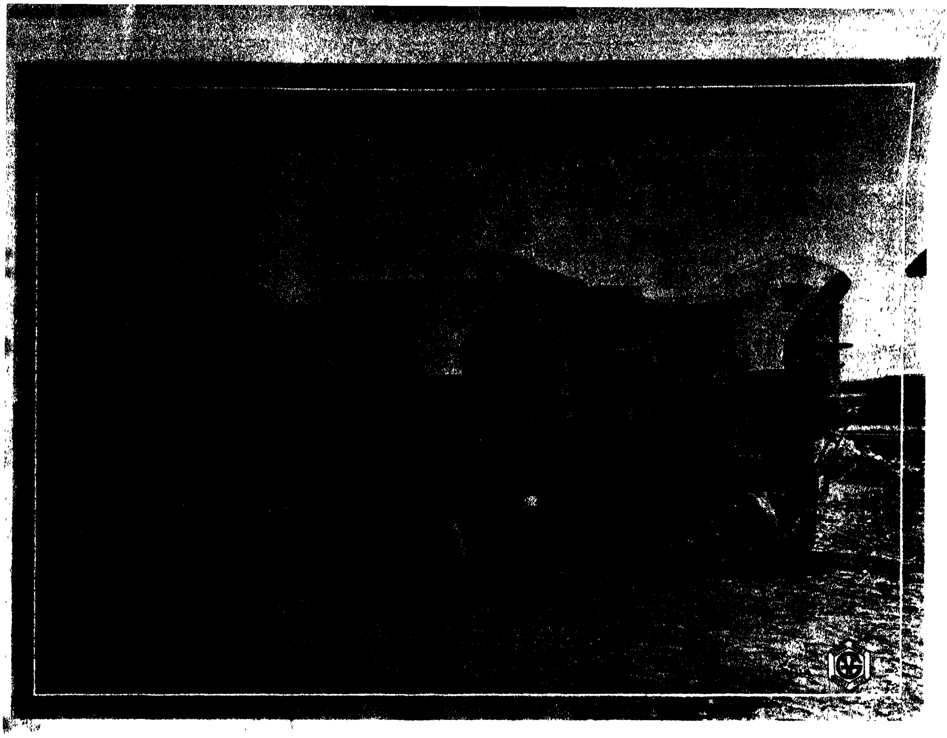
Motor Truck Queries and Answers

P. A. S. writes: "I want to get a two-ton truck, but am puzzled as to the reasons for the two distinct types, i. e., those having the motor forward of the seat—as in the pleasure car—and those in which the motor is placed directly under the driver's seat and floor boards. Can you give me the advantages of each type?"

A. Much depends upon the purposes for which you intend to use the truck and the type and size of body you will find necessary. A motor placed forward of the driver's seat, under the conventional hood, is exceedingly accessible and nearly all parts can be reached easily from a standing position. This design serves to increase the wheelbase of trucks having bodies of only moderate size, and therefore adds to the stability, balance, and ease of riding. Beyond certain limits, however, a long wheelbase becomes a disadvantage. Some designers consider that the motor placed under the driver's seat renders the entire outfit more compact and enables a greater amount of space to be devoted to the body. Although such motors may seem to be somewhat inaccessible, they are in reality easily reached. The driver's seat is either made to tilt to one side or the other, may be removed entirely with but little exertion, or the floor boards and sides may be taken out so that any part of the motor will be exposed. However, the space occupied by the motor of a large truck is so small by comparison with the length of the body that it matters but little whether the motor be placed forward of the dash or under the seat. Leading truck manufacturers produce both styles, and we would not advise that this be a determining factor in the selection of a truck—unless you are to be cramped for room in your garage and need every inch in wheelbase length that you can save.

G. D. P. asks: "Why do we not see more kerosene used as a fuel for motor cars in this country? Do you believe its future lies in its use in the truck or pleasure car? I understand one make of pleasure car has been produced that is intended to use kerosene as a fuel."

A. The fuel problem has not assumed



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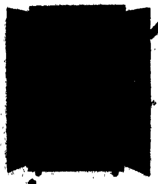

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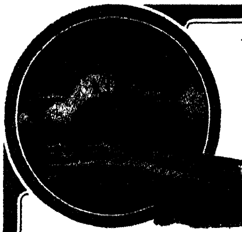

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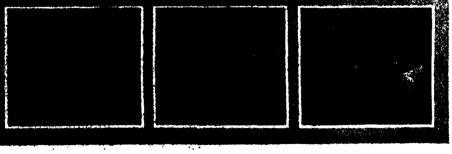

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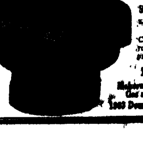

the serious aspects in this country that is the case abroad. It is in the countries in which we find gasoline at forty, fifty, and even sixty cents per gallon that the greatest interest in kerosene carbureter design is manifested. Notwithstanding the fact that one of the leading pleasure car manufacturers has produced a model, a part of the regular equipment of which is a kerosene carbureter, we believe that it is the truck owners who will first take up the use of kerosene on a large scale. The reason for this assumption is easily understood when it is remembered that a touring car can travel from eight to twenty-five miles on a gallon of gasoline, whereas the mileage of a truck on the same quantity will be from eight to ten. Furthermore, gasoline is a much cleaner fuel to use, inasmuch as any that may be spilled when the tank is filled will quickly evaporate without injury to the varnish, upholstery, or other surfaces of the car. Kerosene, on the other hand, is not as volatile, and any drops left on an exposed surface will soon collect dust and detract from the general "spick and span" appearance of the car. As comfort, utility, and pleasing appearance are most sought after in a touring car, and as economy is paramount in a truck, it is evident that gasoline, as it increases in price, will be in greater demand for the former than for the latter.

Winter Sports in Switzerland

(Concluded from page 92.)

The social form of tobogganing is bobsleighing, which is unquestionably the most enchanting kind of sleigh riding. The inventor of the "bob" is an American, Wilson Smith, and St. Moritz prides itself on having first introduced this sport in 1890. The bobsleigh is composed of two pairs of steel runners, one behind the other, on which rests a wooden seat, about ten feet long and about one foot from the ground, capable of accommodating from about four to six people.

The bobsleigh is now a machine which is the result of a thousand careful experiments, exactly tested and practically constructed. With it results are obtained of which the inventor at first certainly never dreamed. The putting together of the different parts, the dimensions, the weight, the materials of which these parts are made, the construction of the steering apparatus, the choice of brake, all this the sportsman has to study and carefully test, if he would take part in this modern exercise with the fullest success.

Through the simultaneous bending of the team at the curves, greater swiftness is attained, and in addition time is gained by certain motions, carried out at the command of the leader.

On a straight run, the guidance is comparatively simple, though care must be constantly taken, because slight imperceptible unevenness of the run turns the bob continually from its proper direction, and the steersman has to use the greatest attention. With constantly stretched guiding ropes, he must have the two front runners ever in feeling, and guide the bob softly like a well ridden horse. He must also, by steering with presence of mind, be able to parry at once a possible shake. Therefore, in a kind of way, he uses the qualities both of a good horseman and an efficient motorist.

On the curves, which almost form a semicircle, care is to be taken, in the first place, as to the correct entrance. If the entrance be good, the curve is already half done. If the bob runs with full speed to rise over a summit, then it is necessary to guide it with an iron fist through the curve. In coming out of the curve, the triumph of skill is shown in taking one in the opposite direction steadily and without upsetting.

The runners should be of medium length, and not too thick. Leaden ballast of between 50 and 100 kilogrammes (110 and 220 pounds) is always carried. The lead is fitted in plates under the seat board, more in the middle and behind than in front. The runners must be kept quite smooth, and the steering apparatus and brake be always well greased, in order to work easily and correctly. Another very enjoyable snow sport, in the Alps, is ski-

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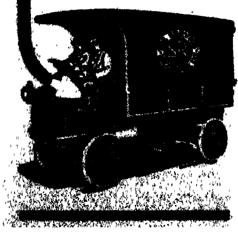

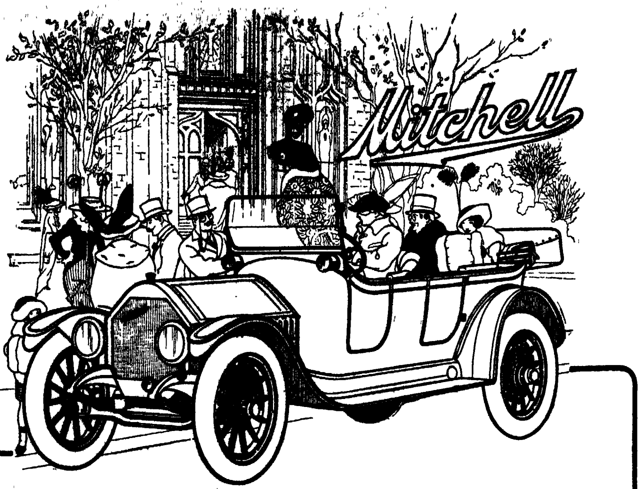

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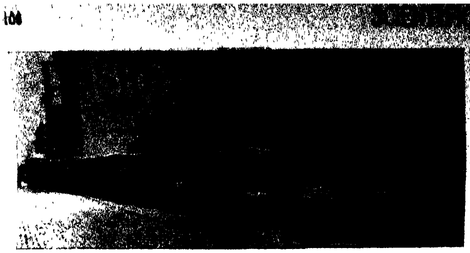

A Motor Truck is primarily and essentially a Truck Motor. For the engine bears the brunt of the work. It must conquer the 30% grade; must forge along under overload; must be able to run hour after hour at maximum governed speed; must withstand the misuse of green drivers. Against the negligence of hired drivers, as well as against the competition in trade, the owner must guard himself. He does—with a Continental motor.

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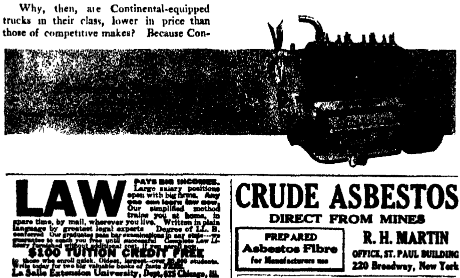

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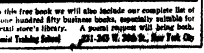

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ing. Its home is in Norway. As a [illegible] and indispensable means of [illegible] it has been used there for centuries. In past times it has been taken up, in a [illegible] fashion, by many countries. As a sport, however, ski running, even in Norway, is still in its youth. The peasants in Telemark, a Norwegian valley, were the first to make the ski a sporting implement. We must thank them that skiing quickly made its way. The performances of the Norwegian ski runners cause universal admiration. Everywhere the ski quickly found a hearty reception, and, to the present day, the number of its votaries increases unceasingly.

There are various shapes of the ski, short and broad, long and narrow, and all with their special purpose, but no form is so well suited for use in mountains, forests and lowlands as that of the Telemark valley.

The length of the ski should depend on the height of the runner; he should just be able to reach their points, when standing upright with outstretched arms, the ski being placed perpendicularly on the ground. Only ash or hickory is used, other kinds are hardly worth consideration. Ash, especially the mountain ash, gives a superior material. Hickory is harder and wears better but is heavier.

"Binding" is the name for the arrangement used for fastening the ski to the foot. Every year new methods are brought out, and patented, but the fundamental system is hard to improve upon.

As further requisites for the ski runner should be mentioned the single and double stick, the fur lining to prevent back slipping, and when on a tour, extra straps and ski points, carrying straps and repairing materials, ought to be provided.

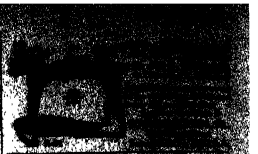
It may interest some to read of gigantic jumps on skis. The longest known jump, to the present time, was executed by T. Smith with a distance of over 49 yards, from the Bolgen jumping platform at Davos, but unfortunately he fell, so that this performance could not be counted, and the record for acknowledged jumps is held by his brother H. Smith with 48 yards. Those astonishing performances attract large crowds of on-lookers.

Foolproofing the Motor Truck

(*Concluded from page 97.*)

which formerly received but scant lubrication, are now provided with grease cups which require only a quarter of a turn each day to supply the necessary lubrication to these parts.

In considering the points covered in the foregoing article, it must be remembered that such designs and attachments as mentioned will not be necessary on all trucks, for many commercial vehicles are designed especially to serve the purposes of those firms who intend to employ only expert chauffeurs. Even such drivers, however, are not perfect, and the tendency of modern truck design is to eliminate all cause of worry on the part of the owner. But, paradoxical as it may seem, in eliminating a part of the "personal element," it is a psychological fact that, in one instance, at least, it has been catered to. The growing application of electric starters to motor trucks is based, not so much on the desire to save work for the driver, but rather on the wish to overcome the one feature of gasoline truck operation in which the electric vehicle was formerly far superior. No matter how expert a driver may be, he will be almost certain to leave the motor running during short stops, and if these are frequent, the gasoline consumed by the motor when the truck is idle may exceed the amount of fuel used during the actual progress of the vehicle. Furthermore, if a gasoline truck is used under these conditions on routes on which the stops are close together and of varying duration, the wear and tear on the motor will be at least appreciable at the end of the year. It is the attachment of the starter, therefore, that is expected to overcome this objection to the use of a gasoline truck for short hauls and frequent stops, for it is hoped that its appeal to the driver's mechanical instincts will prompt him to use the device in preference to leaving the motor running.



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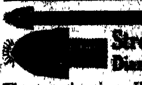

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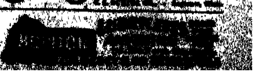

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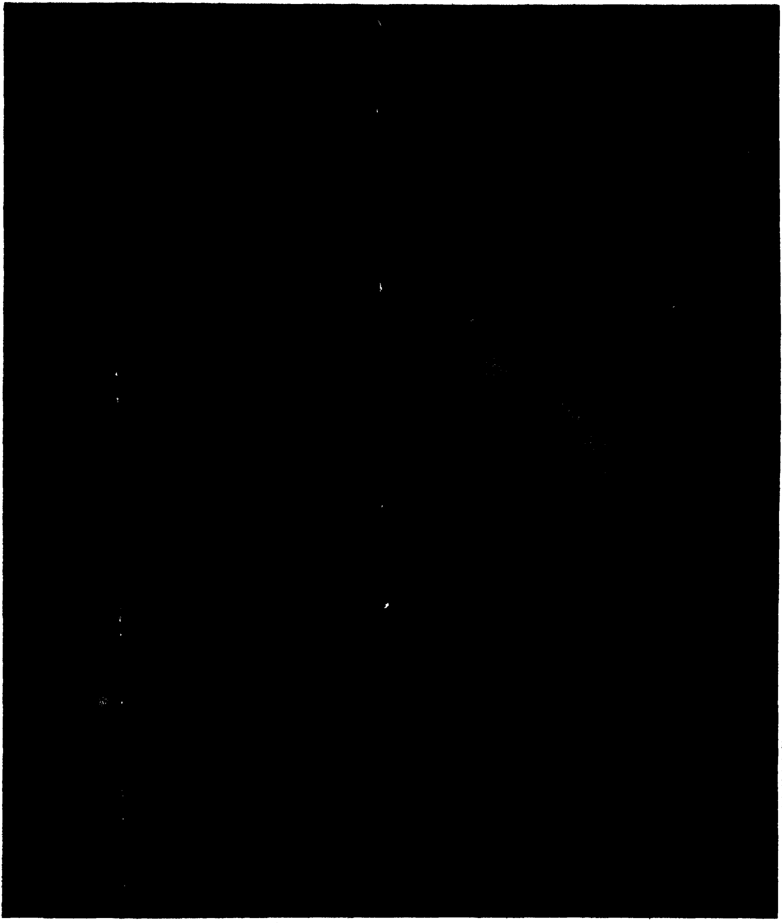

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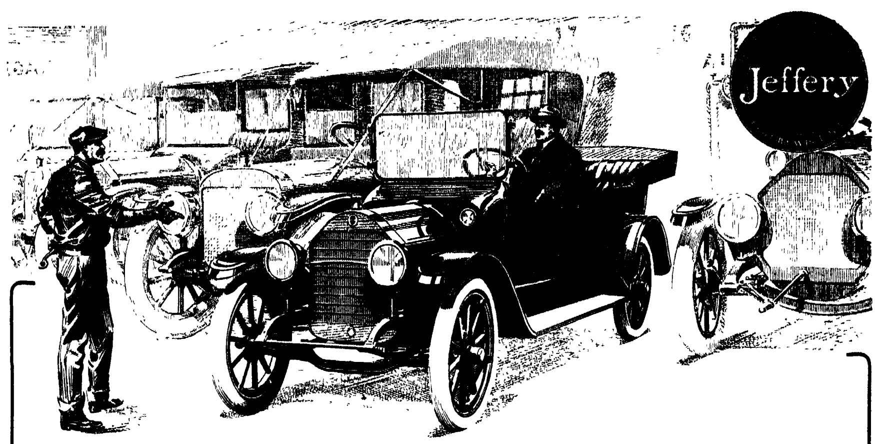

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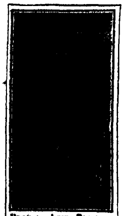

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35 Nassau Street, New York

This Dividend ranges up to 40% of the Premium on Whole-Life Policies

In *subsequent* years, POSTAL LIFE policyholders can deduct the *agent's renewal-commission* of 7½% as paid; also an *office-expense saving* of 2% making up the

Annual Dividend of 9½% Guaranteed in the Policy

The Company also apportions and pays the *usual contingent dividends* that other companies pay.

Furthermore the Company's Health Bureau performs an important service in *health conservation* by issuing Health Bulletins for the benefit of its policyholders and by granting to those who desire, one medical examination each year at the expense of the Company, thus detecting incipient disease in time to check or cure it.

By doing business through the mails—*directly*—it not only effects important savings for policyholders, but also brings the benefits of insurance-protection and health-conservation to the *remotest sections of the country*, thus performing a public service akin to rural free delivery and the parcel post.

For the reasons here stated and others, the POSTAL LIFE is justly designated "The Company of Conservation"—of *money* and of *health*.

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First: *Standard policy-reserves, now nearly $10,000,000. Insurance in force nearly $50,000,000.*

Second: *Old-line legal reserve insurance—not fraternal or assessment.*

Third: *Standard policy-provisions, approved by the State Insurance Department.*

Fourth: Operates under strict State requirements and subject to the United States postal authorities.

Fifth: *High medical standards in the selection of risks.*

Sixth: *Policyholders' Health Bureau arranges one free medical examination each year if desired.*

Write at once and find out the exact sum the Company will save you at your age on any standard form of contract—Whole-Life, Limited-Payment Life, Endowment, Joint-Life, or on a Monthly-Income Policy.

No agent will be sent to visit you: the POSTAL LIFE does not employ agents. Call at the office or write for full official information. Simply say:

Mail me insurance-particulars as per advertisement in SCIENTIFIC AMERICAN for Feb. 7

In your letter be sure to give:
1. Your full name. 2. Your Occupation.
3. The exact date of your birth.

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WM. R. MALONE, President
35 Nassau Street, New York

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As a manufacturer you have made your machinery efficient, but have you maximum fire insurance to protect adequately your efficient machinery?
We furnish indemnity, but as well a service of efficiency engineering on

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We will tell you about this service without charge. Write us

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Their Origin and Development

An important series of papers giving a historical resume of the rotary pump and engine from 1588 and illustrated with clear drawings showing the construction of various forms of pumps and engines. 38 illustrations. Contained in Supplements 1109, 1110, 1111. Price 10 cents each. For sale by Munn & Co. Inc., and all newsdealers.

What are You Doing to Get Repeat Orders?

There's only one reason why a wise automobilist purchases the same make of car TWICE. And that is, because he figures that this particular make of car gives longer, better service than ANY OTHER car of the same class. YOU know that a car's life and usefulness depend on bearings, as on few other things.

HIGH SPEED
NON-GRAN
BEARING BRONZE

The Only Non-Granular or Fibrous Bearing Bronze

Wears Twice as Long as Any Other Bronze Made

That's a fact about which there is no dispute, and it's a fact you can easily settle for yourself (as many leading car manufacturers have already done) by writing for special information as to how NON-GRAN will fit YOUR particular needs, preferably sending blue prints.

AMERICAN BRONZE COMPANY
[illegible] CARTON BLVD.
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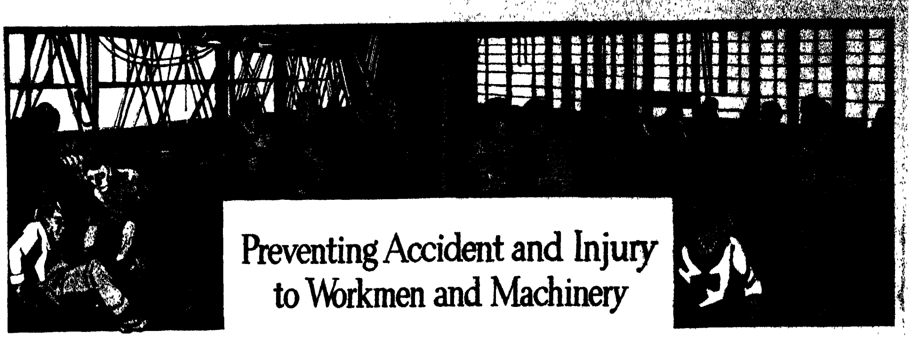

Preventing Accident and Injury to Workmen and Machinery

"AN ACCIDENT!" The news flashes through the plant. There is a scurrying of many feet, then a lull.

"Anybody hurt?" is likely to be the first inquiry. Maybe the answer is, "Bretley broke his arm." Or may be the answer is, "Just a scratch, but the big cutting machine is a wreck."

It is a familiar story repeated with thousands upon thousands of variations month after month. The Manufacturers' Association says that 500,000 *avoidable* accidents occur within a year.

"Avoidable." Men are turning to that word—they have begun to consider safety with more care than ever before. New York established a Museum of Safety. A Congress of Safety has gone deep into this vital problem of applied conservation.

Safety is being made a science—"Safety First," a watchword.

And the science of safety finds its chief safeguard in *mechanical security.* To attain mechanical security in all the many avenues of its application no step is more direct than that made possible by Electricity.

For example, electric motors placed within the base or frame of a machine so as to drive the machine with gears or belts that are totally enclosed, make it practically impossible for man or woman to have clothing caught and life endangered.

Power application in this form cuts out all the many dangers of overhead shafting—the danger of falling sections, belt wheels, broken belts, which have filled the history of American manufacturers with so many tragic chapters.

Beyond this, it directly decreases fire danger by eliminating bearings that may be overheated to the point where they cause fire, as well as other frictions that are a constant fire danger.

The method of control is another "safety first" feature of the electrically operated shop. Motors are started and stopped by push buttons, located at the most convenient point on each machine. Whenever an overload or other unnatural condition of operation occurs, the motor stops automatically—*before* the condition becomes dangerous. This method of controlling power eliminates to a large extent the "personal element" as a factor in safety.

To decrease fire danger is to reduce insurance rates. In a still larger sense the increased safety of electrical power and motor drive are themselves an insurance that means unquestionable economy. It was declared at a session of the Manufacturers' Association that "a conservative estimate of the economic loss in this country, through industrial accidents, places it at a quarter of a billion dollars each year." The actual experience of manufacturers who have installed the modern system of using power made possible by electricity, proves that an immense reduction in the number and seriousness of accidents and injuries, and a vast saving of money penalties, may be confidently counted on to follow the extension of this system.

Add to this insurance the productive advantages of the motor drive method, in small plants as well as in large plants, the low cost of installation and of maintenance, the labor economies, the advertising effect of a clean, lighter, more attractive-looking plant, and the business wisdom of this method needs no further argument. Take up the matter today with your electric power and light company or any General Electric Company dealer or agent in your vicinity. You will find them more than glad to cooperate with you, and no matter how complex your problem may be, they have at their command the service of any part of our organization that may be most helpful to them and to you.

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Trade Mark

GENERAL ELECTRIC COMPANY

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SEVENTIETH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, FEBRUARY 7, 1914.

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Electric lighting and starting equipment for motorcycles.

Electrically Lighted and Started Motorcycle

WHEN, about a year ago, one prominent manufacturer of motorcycles placed on the market a machine equipped with an engine starter of the spring type, thus marking a new era in motor bicycle construction, it looked as though the last word had been said. Now, however, there has been placed on the market by another maker a motorcycle which not only has a complete electric lighting system even to the dynamo, but which has an electric engine starter as well. This year in the motorcycle field, electric lighting is common, though so far only one maker has attempted to follow in the footsteps of the automobile engineer to the extent of equipping with an engine starter, too His machine is shown by the accompanying illustrations.

Compactness in the electrical equipment is absolutely necessary, of course, and this has brought about the development of a clever combined generator and starting motor that has a number of individual and highly interesting features. The combined unit is mounted just ahead of the engine, to which it is attached by means of bolts and straps. It drives and is driven through a roller chain which gives a reduction of approximately 2 to 1. The battery has six cells and is split into two units, half being on either side of the frame at the back of the seat post. For operating the head lamp and the tail lamp the voltage is six, but when used for starting purposes the cells are connected in series, giving 12 volts. To start the engine it is merely necessary to close a small switch on the handle bar. Immediately after the engine has picked up its own cycle of operations the switch is thrown the other way, making the necessary connections to charge the battery at six volts. The change in the mechanical unit from starting motor to generator is made automatically as the armature speed is increased. The machine is compound wound and with the batteries in a fully charged condition delivers about 420 watts at [illegible] amperes for starting, the motor being sufficiently [illegible] to [illegible] the gasoline engine at nearly 800 revolutions a minute. The time necessary to start the gasoline engine varies from about four seconds in warm weather to about 12 seconds in cold weather, provided the engine is in good condition.

The construction of the generator-motor unit is novel. The commutator is within the armature coils instead of being at the end of the armature shaft as is usual; thus great compactness is obtained. The four pole shoes are carried on the field piece casting and the brushes are mounted in holders on the case cover.

Obviously, some device to maintain the output of the generator practically constant regardless of vehicle speed is essential and this is contained in a casing mounted just above the generator-motor unit. This device performs a dual service, for in addition to preventing the charging current from mounting too high at high engine speeds it breaks the connection automatically between the generator and the battery when the voltage of the former becomes less than that of the latter, as when the engine is stopped, for instance

The battery, as already has been made plain, is contained in two cases carried at the back of the seat post The casings are substantial and the vents are so arranged that the electrolyte cannot be spilled in the event of the machine's being turned on its side. The generator-motor unit is quite small, measuring but 10 inches in diameter and 3½ inches in width.

Graphical Studies of Marriages of the Deaf

THE Volta Bureau possesses a card catalogue relating to 4,471 marriages of deaf-mutes, reported in Dr. E. A. Fay's work entitled "Marriages of the Deaf in America," published by the Volta Bureau. Each card is illustrated by a graphical diagram prepared by Dr. Alexander Graham Bell, exhibiting at a glance the number of brothers and sisters and children of the partners in marriage, and whether they were deaf or not. An analysis of these 4,471 marriages appeared in *The Volta Review*. No information concerning offspring was obtained in regard to 974 of the marriages; and in [illegible] cases the marriages took place within a year of the date of report, so that offspring had not then appeared. Eliminating the above, the table deals with 3,078 marriages of a year's standing or longer; 434, or 14.1 per cent, were childless, so that the children recorded were the product of 2,644 marriages Omitting two of these on account of incomplete returns, the table shows that 2,342 of the fertile marriages resulted in hearing offspring alone, and that in 300 cases deaf offspring were also produced.

Dr. Bell has now presented to the Volta Bureau a graphical study of the 300 marriages which resulted in deaf offspring, showing the ancestry of the husbands and wives, the number of children produced, and how many were deaf and how many could hear. The brothers and sisters of the ancestors are also given, showing how many were deaf and how many could hear, and each chart collates the information scattered through Dr Fay's book relating to deaf relatives in collateral lines of descent The marriages are designated by the same numbers used by Dr Fay in his published work. Additional details, preserved in the confidential archives of the Volta Bureau, are accessible to *bona fide* investigators upon request.

A New Building Material

THE French inventors of a new system of metallic wall covering claim quite a superiority over plaster or wood, and cheapness as well. On the laths are mounted light stamped sheet steel plates of handsome decorative design, made in a variety of standard sizes from 2 feet square up to 6 feet by 2 feet and the like. Ornamental cornices are also used, so that there is no difficulty in giving a metallic covering to ceiling and walls, and the effect is most handsome. The advantages of metal are numerous, for humidity does not penetrate, and good hygiene is secured from absence of microbes and insects. The thickness is not over 0.0012 inch and the weight 4 pounds per square yard. Matched joining of plates gives a uniform surface whose joints the eye cannot detect. Such joints are treated in place so as to be quite tight.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Is Our Target Practice Equal to the Best?

THE SCIENTIFIC AMERICAN recently stated that our target practice was probably no better than that of the other leading naval powers, and not nearly so good as that of one particular navy. We have frequently been asked which particular navy it is that is doing better work at target practice than our own. There is no reason for concealing the fact that it is the British navy which is so greatly in the lead, and that the cause of its superiority, as compared with our own, is its adoption of what is known as the "director system" of firing. Director firing was developed by Admiral Sir Percy Scott, and it was he also who elaborated the system of fire control by spotting, which he gave to an American officer, a close friend of his, when they were on the China station years ago—a system which has been steadily followed and equally improved in both navies for years; which is still in force in our navy; and which was abandoned last year in the British navy in favor of the vastly superior "director system" as devised by Scott.

In the old Scott system, which we are still following, there is a pointer at each gun, who tries to keep his sights continually on the target. When all the guns are loaded the fire-control officer sounds a "buzzer" at each gun, and on hearing this each pointer is expected to instantly fire his gun—*if he is exactly on the target.* If he is above or below the target he must not fire, but must wait for the next round. Now it is human nature to want to be "in the game," and too often the pointer will "let fly," whether he is on or off the mark. If his horizontal wire is above the target by ever so little his shell may drop a thousand yards over the target, if below he may be as much short. The result is that the spotter is bewildered by the wide range of "dispersion" as it is called and does not know whether the range for the whole battery should be put "up" or "down" or left where it is.

Now in the director system the errors due to the human element are eliminated by using one telescope and one pointer for the whole battery. Only one gun—the master or director gun—has a telescope and at this is placed the crack pointer of the whole ship's company. The other guns are trued up in parallel with the master gun and move exactly with it. The master gunner keeps steadily "on" the target, and the instant the battery is loaded he presses the firing button, and the guns being elevated to exactly the same degree, the shots fall bunched in practically the same place, and the spotter on the top of the mast is able to tell with great accuracy how far the splash is "short" or "over."

It is this cutting out of the errors of the individual pointers and consequent bunching of the shots that makes director firing such a great step in advance of the old Scott system, which we are still using. The spotter can quickly pull the salvos onto the target and hold them there unerringly.

Now for results. After spending no small amount of his own money in the purchase of gear with which to test his system on his own ship, Admiral Scott succeeded in getting it applied to a dreadnought, the "Thunderer." This ship was sent out with a sister ship, the "Orion," fitted for individual pointing, as practised by us to-day, and, under exactly identical conditions of wind, weather, range, and speed, she put four times as many shots through the target—at least so said the cabled dispatches at the time. So startling was the improvement that the British government voted the full sum necessary at once to apply the system to the whole fleet.

But there is nothing like first-hand information; and *we have it from Sir Percy Scott himself*, who during a lengthy conversation last year on director firing in general, informed the Editor that *the introduction of director firing had increased the hits in target practice for the whole navy over one hundred per cent.*

What then are we to make of the statement of Rear Admiral Joseph Strauss, U. S. N., Chief of the Bureau of Ordnance, before the House Naval Affairs Committee, on January 19th, that the Scott director system "had been experimented with in the American Navy and found not as accurate or satisfactory as the American method of firing salvos"? The American method is the old Scott method, and we have the best grounds in the world for stating that the director experiments referred to were not the true Scott methods, but only a guess at them, and a very wide guess at that.

This depreciation of director firing by Mr. Strauss is most unfortunate, made as it was to the House Naval Committee, on whom the further policy of advancement so greatly depends. For the information of the House we repeat that the Scott system has never yet been tried out in our navy; the SCIENTIFIC AMERICAN learned last year by personal investigation that director firing is absorbing the closest attention of navy artillerists throughout Europe; that because of the lack of initiative in this matter in our Bureau of Ordnance we are already far behind one great naval power in target results; and that in view of the active work being done in director firing by Germany (to mention one other power), the results of which, the writer is reliably informed, are very promising, we are in danger in falling behind that country in target practice as far as we have in battleship strength.

The "Safety First" Movement

WHATEVER may have been the sins of the great American trusts, a blind and cruel disregard of the physical welfare of their employees was not one of them. To be sure, there have been instances of long hours and arduous labor; but the men who had imagination enough to create corporations capitalized at half a billion dollars and more had also imagination enough to see the business folly of endangering life or of working a man to the point of exhaustion. Taken as a whole, accident prevention and welfare work have been more developed by our great industrial companies than by smaller manufacturers. Indeed, were it not for the salutary laws that have been passed in most States to check the frightful loss of life and limb that has hitherto marked the course of our industrial expansion, it is probable that those merciful provisions which stand not only for humanity, but also for good business, would still be confined to the trusts.

The history of the safety first movement in America is in that respect a duplicate of the history of the movement abroad. Long before the social democrats insisted upon the passing of those stringent accident prevention laws, for which Germany is famous the world over, the larger German manufacturing companies had instituted accident prevention and welfare systems that testified to their humanitarian instincts and their good business sense. Systematic accident prevention is at least fifty years old in Germany; in the United States hardly fifteen years old. While we can hardly boast that we have approached the high standard set by Germany, still the record which we have to show for our fifteen years is creditable indeed.

But much more remains to be done—how much can be gleaned by examining statistics. From a chart which was exhibited by the Prudential Insurance Company of America at the recent International Exposition of Safety and Sanitation, it would follow that there are 25,000 fatal industrial accidents per annum in the United States, and some 300,000 injuries. The more possibility of being able to state in statistics the approximate number of our industrial casualties is a step in advance; for as late as 1908 it was impossible to estimate with any accuracy at all what was the toll we paid in crushed limbs and snuffed-out lives. Now at least we know how vast is the problem to be solved, how much needless suffering we inflict and how much we lose in dollars and cents, because we have hitherto failed to realize the necessity of guarding men as well as machines.

It has been estimated that it costs about $300 to train a skilled workman to perform a new task, and that ultimately he represents an investment of about $2,000 to his employer. Considering the subject of accident prevention from this cold-blooded standpoint, our business policy has not been all too wise.

Now that there is an awakening of employers to the duty which they must exercise, now that employers' liability statutes have done away with the antiquated common law conception of negligence, we may watch for a very marked improvement in deaths and injuries.

As an example of the splendid work which the large corporations are doing in the education of their employees we may instance the Pennsylvania and New York Central Railways and the United States Steel Corporation. Elsewhere in this issue will be found pictures which tellingly set forth what the railroads are doing to make one of the most hazardous of occupations reasonably safe, and how the greatest steel manufacturing company in the world protects the thousands intrusted to its care. The work of the steel company is particularly difficult because it is dealing with employees who come from half a dozen different countries and who speak not one word of English. Railroad companies have their problems, too, because they are dealing with the most ponderous and at the same time the most swiftly moving machinery that we know.

It would be hard to estimate with any degree of accuracy how much money is annually spent in driving home the safety first principle; but it must run well up near a million dollars, if we take into consideration what the larger companies spend in issuing educational pamphlets, in employing lecturers, in installing safety guards in machine shops, and in maintaining splendidly equipped emergency hospitals. That it pays to do this is evident from the figures published by the Pennsylvania Railroad. Surely, the reduction of serious accidents to the shop employees of that company alone from five to seventy per cent is magnificent.

America's Need for an Aeronautical Motor Competition

IF we may credit the reports of progress in aeroplane design, the most serious requirement of aviation to-day is a suitable engine. Inherent stability has been provided in Dunne's invention; automatic stability in Wright's invention; nearly the limit of efficiency has been attained in propeller, wing and body design. When well above the earth, a skilled pilot, in whatever attitude, normal, oblique, or reverse, now feels sufficiently safe. Give the circus aviator a strong, reliable motor; he will perform anywhere, however forbidding the terrain beneath. To strength and reliability add economy, and the commercial aviator will make the aeroplane pay dividends by performing useful service to the community. What aviation most needs, then, is a strong, reliable, economical engine.

America has many motor firms, but too little exchange of ideas. An engine tournament, a public show of merits is needed. A competitive test of all the best aeronautical motors, followed by a published report, would be most serviceable to builders and users alike. An adequate testing plant, established by the United States Signal Corps, is now available at the Bureau of Standards, in Washington. All, therefore, that is required to launch a first-class competition is a monetary prize, or the guarantee of orders on a showing of merit, sufficient to attract the engine builders.

The SCIENTIFIC AMERICAN would recommend that a fund be established for a motor competition similar to that recently held in Berlin. The German Emperor offered, from his private purse, a prize of 50,000 marks for the best German aero motor. This sum was, by contributions from the country at large, soon swelled to 125,000 marks, and resulted in a competitive test of two or three score of the best aeronautical engines. Who will emulate the German Kaiser in America?

In our issue of August 31st, 1912, we commended the movement to establish a national aerotechnical institute. Such an establishment, under direction of the Smithsonian Institution, is now practically realized. It has the co-operation of four departments of the Government, including the Army and Navy, and of various private laboratories and air craft companies. It, therefore, needs only the approbation of Congress to make it truly national. The Aeronautical Advisory Committee of the Smithsonian Institution is especially qualified to receive and properly administer a prize for an aeronautical motor competition, more particularly since its membership comprises delegates from both the Signal Corps and the Bureau of Standards. We would recommend that the proposed prize and competition be placed in charge of this committee.

The Haze of 1912.—The remarkable turbidity of the atmosphere in the summer and autumn of 1912, with its attendant optical phenomena, has generally been attributed, as previously noted in these columns, to the presence of dust from the eruption of Mount Katmai, Alaska. However, the question as to the cause of this haze has recently been reopened by Dr. Barkow, who, as a member of Filchner's Antarctic expedition, observed similar phenomena in latitude 70 deg. south, as early as the middle of June, 1912, and during some months thereafter. Cirrus clouds of unusual altitude were noted, and the illumination of the northern sky at midday (with the sun below the horizon) was so bright that reading was possible for several hours. In other words, the phenomena strongly indicated the presence of some light-reflecting substance at an abnormal height in the atmosphere. As it is not thought possible that dust from Katmai could have traveled to the Antarctic so soon after the eruption, Dr. Barkow suggests that the dust was of cosmical origin, though its effects were probably heightened in the northern hemisphere by volcanic dust.

Science

Radium in Central Asia.—Large deposits of radium are have been discovered in the Ferghana district of Russian Turkestan.

Dr. E. A. Fath, director of Smith Observatory, Beloit College, has resigned his position as director of that Observatory in order to take up work as president of Redfield College, Redfield, S. D. He assumes his new office on March 1.

Captain Scott's Journals, kept by him during his antarctic expedition, have been deposited by Lady Scott in the British Museum, where they have been on view since January 17th, the second anniversary of Scott's arrival at the south pole. They comprise the three small, pencil-written books that were found on the explorer's body by the searching party in November, 1912.

A Swedish Antarctic Expedition, now in process of organization, is to sail in the autumn of 1915 and spend five years in exploring in the neighborhood of Graham Land, the coast of which was explored by a previous Swedish expedition, under Nordenskjöld, in 1902-03. The scientific staff will comprise ten men experienced in polar research. Arrangements are being made to have the expedition provisioned every season by whaling vessels, which have recently become very numerous in that quarter of the globe. The outfit is to include wireless telegraphy.

Steam Otter Trawlers had a phenomenally successful season on the Newfoundland Banks during the past year. This method of fishing has now assumed such importance as to cause anxiety concerning the conservation of the world-renowned Newfoundland fisheries. While the new methods involve less danger and hardship to the fishermen than the old, and are more certain and profitable, it is claimed in some quarters that by destroying spawn and small fish of no commercial value and uprooting the marine vegetation of the bottom, trawling will result in the rapid extermination of the fish and the ruin of the fisheries. In order to discourage this practice, the Canadian Parliament has passed a bill (the Hazen bill) to prevent French otter trawlers from coaling at Canadian ports.

The Newfoundland Reindeer Herds, established five years ago by Dr. Grenfell, have proved as great a success in Newfoundland and Labrador as have the herds of the United States Bureau of Education in Alaska, where the pioneer experiments were made. The original herd of 300 Lapland reindeer has now increased to over 1,200. In northern Newfoundland and in Labrador there are few horses or dogs for haulage purposes, while the Labrador dogs are vicious brutes which attack and devour even human beings. Harnessed to a sled, two reindeer will pull 500 to 700 pounds 30 miles a day, and they are also successful as pack-animals, carrying loads up to 200 pounds. The other economic uses of the reindeer are well known. After another season it is proposed to distribute the animals to the mission stations in Labrador, where eventually the Alaskan practice of lending small herds to the natives will probably be adopted.

The Condensation of Moisture in the Atmosphere—i. e., the initial step in the formation of clouds, fog, rain, hail and snow—has been explained for more than a generation by the presence in the air of myriads of minute (mostly ultra-microscopic) "dust" particles, each of which was supposed to serve as a center of condensation. The well-known instrument invented by Aitken, in 1888, in which, after a small measured volume of air has been cooled by expansion, the resulting droplets of water are inspected through a microscope and counted, is known as the "dust-counter," because it has been assumed that the number of drops formed in this process represents the number of particles of "dust" in the given volume of air. This idea is intrenched in the very latest works on meteorology in the English language, though qualified by the admission that in a highly supersaturated atmosphere, such as may be produced at will in laboratory but hardly occurs in nature, condensation also occurs on ions, in the absence of "dust." However, if we turn to recent German meteorological literature (e. g., Wegener's "Thermodynamik der Atmosphäre" or the third edition of Hann's "Lehrbuch der Meteorologie," now appearing in parts) we find that a new idea, after slowly taking shape in the scientific journals for several years, has now definitely crystallized into the belief that "dust," in any ordinary sense of the term, has comparatively little to do with condensation in the atmosphere. Yet it is still believed that the water-droplet forms around a something-or-other that is not water. Ignorance as to what this something is finds expression in its non-committal name of "nucleus" (German Kern). Perhaps it may be a molecule of a hygroscopic gas. Several such gases occur in small and variable amounts in the atmosphere. The whole subject is still in a highly problematic stage, the only definite fact being that "dust" has been shorn of its time-honored function as a cloud-maker, and that Aitken's Staubzähler has become a Kernzähler.

Aeronautics

A New Military Aeroplane.—On January 16th last, the aviator Espanel tried out at Villacoublay a new armored military biplane, constructed in accordance with plans furnished by the French Ministry of War. The apparatus is intended to repel dirigibles. It is armed with a rapid-fire machine gun.

Charles K. Hamilton.—An amazing career was that of Charles K. Hamilton, the aviator, who recently died in New York city. He was in the air before there were flying machines, for he it was who with cat-like agility saved himself from injury in more than one fall in experimenting with Israel Ludlow's gigantic kites. When the aeroplane appeared, Hamilton was in his element. His swoops and his dips thrilled thousands of spectators when flying was still a novelty. Perhaps his most notable exploit was his flight from New York to Philadelphia and return on June 13th, 1910—one of the most important cross country flights of its day.

Aerial Stowaways.—The enormous biplane built by Sikorsky was referred to in this column some weeks ago. A correspondent of the London *Telegraph* who resides near the military aviation ground at St. Petersburg, where the machine was berthed—no shed was large enough to contain it, so it had perforce to be kept in the open—and had frequent opportunities of observing the huge machine, both in the air and on the ground, supplies his paper with the interesting information that when the great biplane was well up in the air on one of its first trial trips, two workmen were discovered in the cabin who had stowed themselves away for the purpose of stealing a trip in it.

The Wright Stabilizer.—At a recent demonstration of the Wright stabilizer before the committee which awarded the Collier trophy to the invention, something more was revealed of the side control. It seems that in the actual device a gradual effect is assured, because a windmill takes the place of the servomotor which we described in our recent article on the stabilizer, and because a clutch is substituted for the three-way valve. An auxiliary propeller is rotated by the relative wind and thus furnishes an amount of power for working the side control, strictly in proportion to the disturbing force. A clutch, moreover, is obviously capable of a graded effect. Vanes might be provided to make the windmill face side gusts squarely. The idea of deriving proportionate power from the air itself in combination with pendulum control is certainly most ingenious.

Navy Flying Machine.—That aeroplanes should eventually be placed aboard all battleships was one opinion out of a number of important conclusions recently arrived at by a board of officers appointed for the purpose of drawing up a comprehensive plan for the organization of a naval aeronautic service. The board ordered by the Secretary of the Navy was composed of the following officers of the Navy: Captain W. I. Chambers, senior member, and Commanders O. B. Britain and S. S. Robison, Lieutenants M. H. Simons and John H. Towers, Naval Constructor H. C. Richardson and First Lieutenant A. A. Cunningham of the Marine Corps. The board emphasized the opinion that aeroplanes should eventually be placed on board all battleships. Also, that any group of ships on scouting duty or detached service, will require their services. The bulk of the stores, supplies and implements for these aeroplanes should be carried by the fleet auxiliaries so as not to encumber the fighting units. Special ships for aeroplanes and air craft generally should be considered, though not immediately recommended.

Prizes for 1914.—The most important prize to be won in 1914 is that of $25,000 which is open to British-built aeroplanes and engines over a 1,540-mile circuit of the British Islands, with an additional prize to the engine constructor. Then there will be a first prize of $25,000 for the best performance in a reliability trial, of a British-built engine, with an additional $200,000 in orders. Other big prizes which may be won in 1914 are $50,000 for the first aviator to fly from Europe to America; $100,000, with several minor rewards, for an aeroplane offering the greatest degree of safety, this competition being started by the Union Aerienne de France, and open to constructors of all nationalities; $2,000, offered by the Paris Municipal Council, for a race from capital to capital, probably to some place in the Near East, via Vienna and Budapest; $5,000 for a hydro-aeroplane race of 150 nautical miles, open to all nationalities, organized in connection with the Coupe Jacques Schnieder; $4,000 for an all-around France competition with sixteen stopping places; $4,000 for the circuit of Paris competition, the distance being about 125 miles; $2,500, offered by a newspaper, for a flight across Africa from Cairo to the Cape, the distance being about 5,600 miles; a prize to be given to the first pilot reaching Johannesburg; $2,000, offered by the Aero Club de France, for the longest direct non-stop flight; $1,800 Michelin prize for the greatest number of hits on a given target in competition for bomb throwing from aeroplanes.

Automobile

Lubrication of Worm Drives.—Advocating the use of either castor, sperm or lard oil for the lubrication of worm drives, Mr. Lanchester, inventor of the type of worm and wheel that bears his name, suggests that one is about as good as the other provided it is pure and free from acid. He suggests, too, that a mixture of any two of them may be better than one alone, for when they are mixed better control of viscosity is obtained. Thus, for instance, lard oil which has a tendency to solidify at temperatures lower than normal can be made more suitable and this objection removed by the judicious addition of sperm or castor oil

Spring Suspension of Cycle-cars.—Because of their light weight and narrow tread, the spring suspension of cycle-cars manifestly is a matter of the gravest importance. In this connection, it is interesting to note that of late several engineers prominent in the automobile industry have offered as their opinion that the cantilever type of spring seems best adapted for these light little vehicles. This type of spring possesses two cardinal advantages: It is less expensive to manufacture than many other types and in action eliminates practically all of the uncomfortable and often dangerous rebound that is a feature of nearly all other springs.

Danger in Over-powering Light Cars.—With the marked stimulus that has been given the building of light cars during the past few months there becomes apparent a danger that would seem to have been overlooked by a majority of manufacturers It is, briefly, that it is quite possible to over-power these little vehicles. As light vehicles they scarcely are calculated to withstand the abuse that must follow as the result of the possibility of high speed, which always exists as an invitation to the owner to exceed the moderate rate of speed conducive to longevity. With the powers that are being used in those cars that have put in an appearance, it is to be feared that odium will fall on the class almost before it has become established. Perhaps some sort of an engine-governing device would solve the problem.

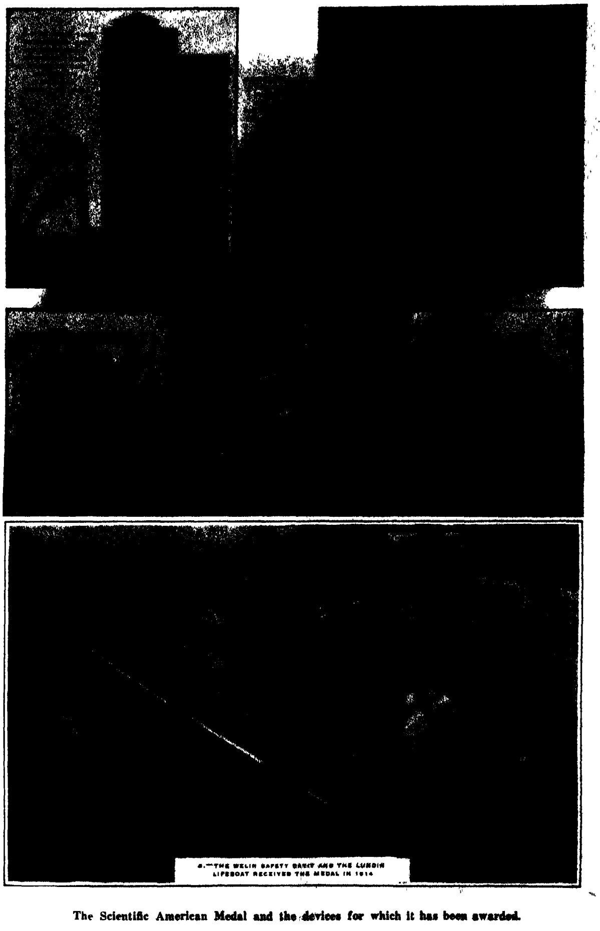
Noteworthy Performance of Knight Type Engine.—As a matter of record, the performance of a Knight type sliding sleeve valve engine recently under test at the hands of the Automobile Club of America is of considerable interest inasmuch as a new world's record for continuous operation was established The motor actually ran a total of 336 hours with the throttle wide open and the dynamometer load adjusted to hold the revolutions to 1,117 a minute The average horse-power developed, the bore and stroke being 4 and 6 inches respectively, was 38 3; maximum horse-power developed on a subsequent test was 53 6 at 1,682 revolutions per minute. The gasoline consumption during the test was 1,744 gallons, though this figure, unfortunately, is inaccurate for the reason that an undiscovered leak in the fuel line increased the consumption The average consumption during the time when, presumably, there was no leak was 31.5 pounds an hour, and during the last 10 hours this dropped off to 30 8 pounds. The gasoline tested 61.6 Baumé at 60 deg. Fahr. All told, 131 6 gallons of lubricating oil were used. At the conclusion of the run, the motor was found to be mechanically perfect and unusually free from carbon deposit, the sleeves and ports were free from burns and the piston rings were free. Throughout the run no trouble of any kind was experienced, except that the fan belt broke, and after being replaced once, finally was discarded after it again failed.

The Electrically-operated Brake Appears.—There has just been placed on the market—it was exhibited at the recent automobile show in Grand Central Palace—a novel and interesting mechanism for electrically operating the emergency brake on automobiles. Briefly, the apparatus consists of a tiny electric motor operating at extremely high speed and driving through worm gearing a drum over which a cable attached to the brake actuating mechanism is wound. The motor draws current at six volts from the battery used for the electric engine starter. The control is placed on the steering column and is one of the most interesting parts of the whole assembly. When the lever is moved so as to close the circuit and open it again immediately, the electric motor is set in motion, but the movement of the drum is limited by the action of an automatic circuit breaker which cuts off the current when the drum has made a predetermined part of a revolution. As the drive is through worm gearing, the brake cannot release itself and remains lightly applied. Subsequent movement of the control lever in the same manner repeats the process, applying the brake still more tightly and a further repetition of the initial function permits further revolution of the drum, applying the brake with the maximum pressure. A friction clutch between the motor and the drum protects the cable from breaking. The brake may be released progressively, as it is applied, or at once. Similarly, moving the control lever the limit of its travel applies the brakes to the maximum pressure almost instantly. The apparatus may be applied to any car, new or old.

The Scientific American "Safety First" Medal

The Five Winning Devices

By William H Tolman Ph D Director of the American Museum of Safety



6.—THE WELIN SAFETY DAVIT AND THE LUNDIN LIFEBOAT RECEIVED THE MEDAL IN 1914

The Scientific American Medal and the devices for which it has been awarded.

AS early as 1867 Dolfus, a French industrialist, aroused by the increasing number of accidents to labor in factories and workshops, due to the fact that there was little or no attention paid to the safeguarding of dangerous machinery, organized an association for the prevention of accidents, and founded what was the beginning of a museum of safety devices. To-day some of these original models may be seen in an honored section of the Paris Museum of Safety Devices. In 1890 a museum of safety devices was opened in Vienna; in 1893 a second in Amsterdam, followed by similar organizations in Munich, Berlin, Moscow, Zurich, Paris, and Milan, until now there are twenty-five museums of safety.

One of the most encouraging signs of the moral uplifting of the race is the unmistakable growth in these later days of the humanitarian sentiment. The dignity of the human body, the sanctity of human life, are swiftly emerging to their full and proper recognition. The reproach has lain too long at our doors that, as a people, we were so madly bent on the pursuit of wealth that we cared little who might fall by the way, if only the goal were swiftly and grandly won To the question "How much then is the life of a man worth more than a sheep?" we have made answer by rolling up a record of over half a million annual maimings and killings that may well put us to the blush Therefore it is gratifying to realize that the movement set on foot by the American Museum of Safety for the promotion of an American museum of safety devices is meeting with marked success

After seven years of vicissitudes the Museum has emerged as a great institution for promoting safety. The work of the Museum has often been commented upon in the SCIENTIFIC AMERICAN

To further stimulate the prevention of accidents and the promotion of industrial hygiene, five gold medals are placed at the disposal of the American Museum of Safety for annual award. Three of these are in general fields. One, the E. H. Harriman Memorial Medal, founded by Mrs. E H. Harriman, will be competed for by American steam railways, for the best record in accident prevention and hygiene, affecting the public and its own personnel, during the current year A fifth medal, known as the Rathenau Gold Medal of the Allgemeine Elektricitäts-Gesellschaft of Berlin, is to be awarded for the best device or process in the electrical industries, safeguarding industrial life and health, made through an American institution The last award in the series will be the Anthony N Brady memorial medals.

The oldest medal is that given annually by the SCIENTIFIC AMERICAN, and, therefore, it is fitting that in a special number devoted to "Safety First" we should review the five awards which have been made of it

In 1908 the award was given to a device for safeguarding life at sea. Fire on shipboard is as much a crowning horror as a collision, and any means of detecting it and putting it out should be added as equipment to all vessels. The award was made to the Rich Marine Fire Indicating and Extinguishing System.

A brief description of the device will prove of interest A pipe runs to each hold, storeroom, bunker, etc., where it terminates with a flat cap or smoke collector. The pipes from the various holds and bunkers are assembled from fore and aft and are carried to the bridge or to the wheel house. Here they are arranged in banks in a case, which is practically air-tight. Each pipe has a removable smoke spreader bearing a number. Directly over the pipes is an electric fan which can be actuated continuously or at intervals. In front is a clock provided with means for making contact with an electric bell every fifteen minutes. It is the duty of the officer of the watch to set the motor in motion if it is not running continuously, and to look through the glass front at the pipes. Very little suction is necessary to draw the smoke from any incipient fire, and it is readily detected with the aid of the electric light which is inside the case. If no fire is found the officer "rings in" on a time clock like a watchman's detector, showing that he has made the proper inspection.

In 1909 there was no award, but in 1910 the SCIENTIFIC AMERICAN Medal was given to the Patent Scaffolding Company of New York for the design and construction of masons' suspended platforms. The following is a brief description:

The construction will readily be understood by reference to the engraving. The scaffold is interrupted so as to make sections ten feet long. At the ends of each section of planking are a pair of winches secured to a horizontal iron beam serving to support the planks. The winches are composed of a drum around which wire rope is roved, and the necessary supporting members. The upper end of the wire rope is secured to an outrigger by an anchor bolt, thus serving to support the scaffold. To the drums are secured ratchet wheels. A lever serves to actuate a pawl, which raises or lowers the scaffold by means of the ratchets which serve to turn the drum which winds up the cables. As the sections are small, one man can raise his section very quickly by a few strokes of the four levers at each corner.

1911 passed without any exhibit being made which was worthy of the medal, but in 1912 it was awarded to the Norton Company for their well-developed and carefully thought out accident prevention devices applied to grinding wheels. The company has at all times made an effort to fool-proof in every possible way all apparatus of its manufacture by means of safety hoods, flanges, etc. In addition to the specially referred to safety devices, accidents from other sources have been guarded against, by means of proper housings of all gears or other pieces of mechanism, also stops which prevent the mounting of a larger wheel than the given machine has been designed for; dust suction systems for the protection of both operator and machine; leather spark brushes, so attached to the hood as to protect an operator's clothing from sparks; adjustable rests, etc. In 1912 the SCIENTIFIC AMERICAN Medal was awarded for the fourth time. This year it went to the Draeger Oxygen Equipment Company for their "Pulmotor," which possesses such human interest for the many lives it has saved in cases of gas poisoning and electric shock as well as drowning.

The cylinder contains 11½ cubic feet of pure oxygen. The oxygen passes from the reducing valve to an injector which has the property of drawing in a large volume of air with a certain force of suction, and propelling that air forward with equal force through the flexible tube in front of the injector. This suction and delivery injector, therefore, serves as a motor, alternately filling the lungs by pressure and emptying them

(Concluded on page 130.)

The Business Side of the "Safety First" Principle

How Accident Prevention Pays

By David S. Beyer, Manager Accident Prevention Department, Massachusetts Employees' Insurance Association

ANYONE who visited the recent exposition of Safety and Sanitation at the Grand Central Palace in New York, must have been impressed, especially if he were previously unfamiliar with the scope of the safety movement in the United States.

Even those who were best acquainted with what is being done all over the country for the prevention of accidents, could not restrain their expressions of surprise that so much safety material from so many varied sources could be gathered in a single exhibition hall. It reminded one of an annual automobile show, in the variety of equipment represented and the enthusiasm with which the proprietors of the various booths displayed their exhibits to visitors.

To be sure, some of them had an eye to business; the man who broke dollar goggles for all comers just to show how strong they were, undoubtedly expected to recoup his losses through future orders. This, however, could not be the controlling motive that induced Germany and Holland to send their contributions from across the seas, nor did it influence the United States Steel Corporation, the New York Edison Company, the Westinghouse Electric Company, the Pennsylvania, Chicago and Northwestern and Baltimore and Ohio Railroad Companies and scores of others who do not manufacture safety devices for sale.

Anyone who came away without realizing that the safety movement is on in earnest in this country must have kept his eyes shut and his ears closed.

Ten years after Spain passed her first workmen's compensation act, we began to adopt similar acts in an effort to correct the long standing wrong.

Germany made the start thirty years, and England fifteen years ago.

But when we move, we move quickly. With the safety movement scarcely six years old in this country, we can point to hundreds of plants which are equal, if not *superior*, to the best in Europe as regards the safety of their employees. And the list is constantly growing.

During that time we have proven several things: in the first place, that *accident prevention pays*. By this is meant not only that it pays from the humanitarian standpoint, but that it is a good investment looked at in terms of cold cash.

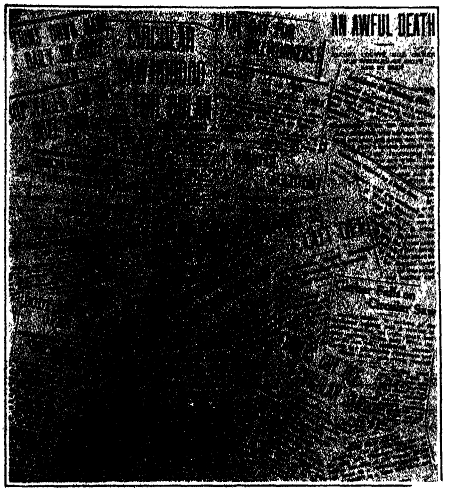
The Economy of Accident Prevention.

This is not the only object that appeals to a business man, but it is a very important one; he must run his business economically, or it will become impossible for him to continue in business. It can now be demonstrated that one of the most effective economies he can introduce into his plant is scientific accident prevention.

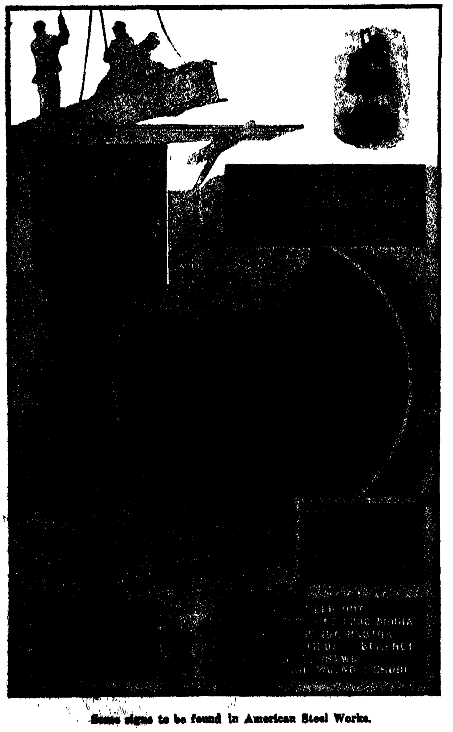
Take for example the appended chart of the United States Steel Corporation, giving the results of six years of safety work; this shows a reduction of forty-three per cent in the accidents to employees during that period; stated in terms of human units, this means that nearly nine thousand men were saved from death or serious injury.

With the compensation of injured workmen costing a million and a half dollars a year, it takes little further calculation to show that the million dollars per year which the corporation has invested in safety devices is paying several times as much as if it had invested the same amount in Government bonds.

And that is *only* the *direct* saving, to which several incidental items can be added. An accident to a trained worker generally means that a "green" hand must be employed to fill his place. It costs money to break in a green man, and in doing so further loss is generally involved, through the reduction of output and the spoiling of more or less good material. Furthermore, this man, being unfamiliar with the hazards in his new work, is likely to injure himself or some of his fellow employees before he is fully trained. Still another possibility of loss confronts the employer. The new man may after all prove unsatisfactory for the work, and have to be replaced by a third man, thus doubling the training expense.


AN AWFUL DEATH

Newspaper reports that would not have been published if the "Safety First" principle had been observed.



Some signs to be found in American Steel Works.

It is impossible to estimate these items of cost accurately, but no one can deny that they exist in definite form and that this expense can be saved by avoiding injuries to trained employees.

The Chicago and Northwestern Railway Company has not been working at accident prevention so long as the United States Steel Corporation, but, nevertheless, shows a reduction in accidents for the last three years of 20.9 per cent in the number of persons killed and 23.7 per cent in those injured as compared with the last year previous to the organization of safety committees.

The fact that such committees have been organized in sixty-eight railroad companies, including such systems as the Buffalo, Rochester and Pittsburgh, Chicago, Burlington and Quincy, Chicago Great Western, New York Central, Pennsylvania, Norfolk and Western, Southern, and Union Pacific, etc., indicates how thoroughly convinced the officials of these great organizations are that safety work pays.

The accident reductions which have been obtained by the Eastman Kodak Company may be mentioned as characteristic of another type of industry. As a result of two years safety campaign, decreases in accidents aggregating 44 per cent have been made, as shown by the table on the next page.

Many other cases might be cited, but these are sufficient to show the possibilities of this work

Workmen's Compensation Acts and Accident Prevention.

In considering the saving effected by cutting down accidents, it should be remembered that this item of expense has been growing larger year by year. During the last three years about half the States in the Union have passed workmen's compensation acts, the immediate effect of which has been to multiply by several times the cost of accident settlements.

It is probable that within a short time all States will have similar laws, so that the question becomes much more important financially than it has been in the past, on account of this increase in cost.

The principal way in which this loss can be cut down is by preventing the accidents. When it becomes generally recognized that 30 per cent to 50 per cent of all industrial accidents are preventable, some by mechanical safeguards and others by educating the men not to take chances, a great step will have been taken toward bringing about the desired end.

It must be admitted that as a rule it is the small plant that is the hazardous one, and it is the proprietor of the small plant who is the hardest to convince that safety work is needed. Generally he has heard of numerous accidents occurring in the big plant across the way, and is quite ready to concede that safety work is a prime necessity there, but he feels that conditions are different in his own plant. He has very few accidents, and when one does occur it is the fault of the injured man himself.

He does not stop to think that the reason why there are more accident in his neighbor's plant than in his own, is because it is so much larger, and that in reality he may be having more accidents in his small plant in proportion to the number of men employed. A small plant may go for months or even years without an accident, just as a department of the same size in a large plant may have the same experience; but where several thousand men are working in any industry, a number of accidents are sure to occur every week.

The mistaken idea comes in trying to form a general opinion from a limited field of observation. A wide experience and the knowledge of thousands of accidents are necessary before it is possible to recognize what accidents are common and may be expected to reoccur.

An Insurance Company's Experience.

By way of illustration, the experience of an insurance company covering about nine hundred plants may be cited. During the course of a year there were ninety-six accidents reported from persons falling down stairways. At the same rate of frequency, it would be ten years before this particular accident would occur in each of the nine hundred plants. It is altogether probable that before the end of ten years the first accident would be forgotten, or, even if it should be remembered, those most familiar with the accident conditions would be likely to say that since this kind of accident happened so seldom, it was not worth considering.

As a matter of fact, one hundred accidents from one cause, even in a thousand plants, shows that this is a serious source of hazard, and one which would warrant the expenditure of considerable sums for hand-rails, safety treads, additional lights, etc., by means of which many of the accidents could be prevented. When this is made clear, the safety provisions are usually forthcoming.

Another element which explains the reasons why many people may consider an accident rare and unusual when in reality it is common and of frequent occurrence, is the general tendency to hush up information of this sort as completely as possible.

An accident is an unpleasant thing at best, and everyone likes to forget about it as soon as possible. Thus it sometimes happens that men in the building next to the scene of an accident know nothing about it. The same accidents may be happening all around them, yet when one comes under their personal observation, they consider it a strange and unique "Act of God."

Not long ago an inspector was talking to one of the officials of an electric company about the protection of 500-volt electrical equipment. This official was in a position where he should have been familiar with all the details of the subject as far as his particular company was concerned, having been connected with it for a number of years; yet he remarked, "To my knowledge no one has ever been killed in this company from five hundred volts."

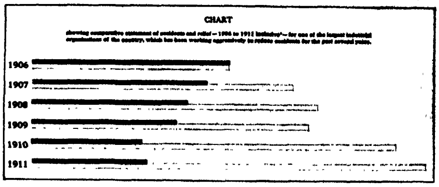
The inspector replied, "To *my* knowledge two men have been killed from this voltage in your own company during the past two years."

This official had not heard of the accidents because, as is common practice, they were kept quiet. When such ignorance of accident conditions exists within a single company, it is not strange that the people in one plant should not know about the accidents in others. Thus the proprietor of the small plant fails to have any conception of the great number of accidents that happen in the industries about him, and the part that he can play in reducing his small proportion of the whole.

It is an unfortunate thing that there must be accidents, but when they do occur, it is still more unfortunate if the one valuable result is lost: this result is the lesson which might be learned from one accident, to the end that other accidents of a similar nature might be prevented.

One of the things that is very much needed is greater publicity as to the accidents which occur, and the manner in which they occur. The records published by the various States, with two or three notable exceptions, are so vague and indefinite as to be of no value whatever from this standpoint; one of the important aims of correlating the various safety movements in different parts of the country, should be the accumulation of accurate statistics, classified along uniform lines, and giving sufficient detail to convey a definite impression as to the exact causes of the vast number of accidents occurring every year.

The pioneer work in accident prevention has been done. It has been demonstrated that accident prevention pays from the financial standpoint, as well as from the more important aspect of humanitarian considerations. The way in which accidents may be prevented has also been well marked out, and is constantly being more clearly defined. What is now needed is widespread publicity, so that every man in every industry in our country may know the advantage of this great movement, and do his part to carry it forward.



Heavy lines show reduction in serious and fatal accidents among employees of the United States Steel Corporation, using 1906 as a basis. Dotted line shows increase in total casualty expenses per employee, using 1906 as a basis. The increase is explained by the fact that the corporation in question has made more and more liberal payments to its injured men, until, in 1910, it adopted a voluntary compensation scheme, in which all men injured in the regular course of their employment are compensated, regardless of whether they were partially to blame for the accident or not. The slight increase of serious and fatal accidents in 1911 over 1910 is due to a change in classification of accidents established January 1st, 1911, resulting in more accidents being classed as "serious" than formerly were so classed. The fatal accidents in 1911 were 27.27 per cent less than in 1910. During 1910 and 1911, $3,183,000 was expended for compensation to injured workmen, and $1,750,000 for the installation of safety devices. *The number of serious and fatal accidents shows a decrease of 43 per cent since 1906,* thus indicating that the large expenditure for safety equipment was amply justified, and gave a good return on the investment.

COMPARATIVE STATEMENT OF ACCIDENTS PER 1,000 EMPLOYEES FOR THE YEARS 1910, 1911 AND 1912.

Nature of Accidents.	Rate per 1,000.		
	1910	1911	1912
Fingers and hands between punch presses and shears	14.38	9.28	4.30
Fingers and hands against woodworking saws	4.79	4.41	2.69
Fingers and hands into woodworking cutters	2.18	2.32	1.25
Bruises, burns, lacerations and injuries of minor importance	44.74	38.41	27.97
Falling off ladders, platforms and slipping	10.91	6.26	6.45
Injured around elevators	.80	1.39	.72
Injured around emery and other grinding wheels	3.46	1.16	1.61
Obstructions in passageways and doors	.53	.46	1.25
Falling tools, materials, etc	9.59	7.42	4.65
Fingers and hands under drilling and boring machines	8.53	1.86	3.41
Fingers and hands into automatic screw machines	1.07	.70	.90
Injured around lathes and milling machines	4.79	.46	.72
Stepping on nails	4.00	2.55	2.05
Injured on machines of special nature			2.15
Total accidents per 1,000 employees per year	109.72	71.68	61.13
Reduction of accidents per 1,000 employees since year 1910		38.04	48.59
Percentage of reduction		34.67	44.29

A Wireless Danger Aboard Ship

THAT wireless may at times prove dangerous aboard ship, has just been pointed out by the United States Bureau of Navigation, Department of Commerce, part of whose duty it is to see that the laws governing the use of wireless telegraphy are obeyed. The same wonderful means of communication which already has saved the lives of so many at sea, may result, if not properly guarded, says the bureau, in a danger and a menace rather than a safeguard to some vessels.

The bureau is preparing to call the attention of the entire shipping world to this danger, and through its inspectors to warn them. The danger is that electrical sparks may set fire to vessels carrying gasoline or other substances which generate an explosive gas.

In a communication which has just been sent out to radio inspectors by A. J. Tyrer, acting commissioner of the bureau, the following statement is made:

"When inspecting the radio apparatus on tank vessels or cargo vessels carrying gasoline or similar substances which generate an explosive gas or any other explosive which might be ignited by electric sparks caused by the operation of the radio apparatus, you will pay particular attention to the insulation of the antennæ, to metallic rigging or equipment of the vessel in which currents may be induced by the action of the radio apparatus, and to the wiring and electrical equipment of the vessel in which currents may be induced by radio apparatus so as to cause sparks to jump between wires or between small gaps.

"In general this matter should be brought to the attention of masters of vessels, steamship owners and wireless telegraph companies.

"If upon inspection sparks of the above character are found, the matter will be reported to the master of the vessel, the steamship company or its agents, and to the company operating the wireless apparatus, and the dangers pointed out."

The operation of radio apparatus on board vessels generates in the antennæ enormous potentials or very high voltages. If the insulation of the antennæ is in any way defective, this high potential causes sparks of electricity to pass over the insulator in an effort to reach ground. In some cases, even though the insulation is efficient, high potential surges are generated in metallic rigging, such as guys, etc., by electromagnetic induction. Small insulated spaces or air gaps are sometimes found in parts of a vessel's rigging in the vicinity of steel guys, etc., and the high potential surges induced in these conductors often jump across the gaps in the form of electrical sparks. It is a very common occurrence on board vessels when the wireless apparatus is operating to hear the crackling of small sparks, and or sometimes at night these small sparks can be seen. In many cases special precautions are taken to avoid this phenomenon, and the guys and rigging are split up into insulated sections in such a manner as to be out of resonance with the radio apparatus so that the surges cannot take place.

Many tank vessels and some of the cargo vessels carry gasoline or similar explosive material and are equipped with wireless apparatus. In some cases vent pipes from the storage tanks are led up the masts and have openings in the vicinity of the antennæ or some of the guys where electric sparks might occur due to the radio apparatus, and it is entirely within possibilities to assume that under certain conditions the sparks might cause an explosion. It is well known that gasoline vapor in explosive engines is ignited by means of electrical sparks which are identical in every particular with the sparks above described.

Oil and Wool from Pine Needles

PINE-NEEDLE oil is a product derived from the leaves of our pines. It has been extracted for a great many years and is well known the world over as a remedial agent against rheumatism and allied complaints. It is a volatile, colorless liquid obtained by distillation of fresh needles, young twigs, and one-year-old cones of our western and southern yellow pines. In order to produce oil of the best quality fresh green needles must be collected during the spring of the year, preferably in the beginning of June. Pine-needle pickers go from tree to tree and select the young, thrifty green leaves at the ends of twigs, which yield about 0.55 per cent of volatile oil. Those of old trees, which are dry and tough, produce much less and of much poorer quality.

A number of years ago this oil was supplied by a number of small stills or ordinary pharmaceutical distilleries. The still itself is a very simply constructed apparatus consisting of a closed copper kettle, into which the material is placed. Steam is admitted under pressure and passed through the contents from the bottom of the kettle. The volatile oil is vaporized by the dry steam and passed off with the saturated steam through a long coiled condensing tube. The condensed steam and oil are collected in a receiver, and the oil, which is on top, is drained off.

There has been an increasing demand for pine-needle oil and the small stills which could not compete with the larger concerns have now practically all ceased to operate. The large distilling plants with all the recently introduced secret devices are now able to produce all the oil required for home consumption and also for export. In this way the oil has not only been improved, but the cost of production has been considerably diminished. Some of the large stills have a capacity of from 30,000 to 60,000 gallons annually. The price of the purified oil varies from $20 to $30 a gallon. Cheaper oils are frequently adulterated with turpentine oil.

The mass left in the kettle after all the oil has been driven off may be regarded as a by-product, and it is sometimes due to the close utilization of this material that the business is made a profitable one. The needles are removed from the kettle and boiled in a soda solution until all the resinous matter and non-fibrous tissue are separated from the fibers. It is next passed through a series of washing, drying, and heating processes, which sometimes require 24 hours. After they are put into a machine to separate and loosen the fibers, they are bleached and put in assorted packages and sent to the different markets, where they are sold for pillow and mattress stuffing. The fiber will retain its odor permanently and is considered very healthful and vermin-proof. It was on account of these two qualities that the best hotels and hospitals of Europe used this fiber in their mattresses.

The material when properly prepared is sometimes known as pine wool which may be spun and woven into fabrics. It is very strong and is advantageously employed for many of the purposes for which hemp is used. In Europe this pine wool is made into jackets, drawers, and stockings of every description as well as flannel for shirts, coverlids and chest protectors. Knitting and darning yarn, quilts, wadding, deadening paper for walls and floors, and a great many other articles are manufactured from this wool.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Labor in South America—a Word of Warning

To the Editor of the SCIENTIFIC AMERICAN:

Now that the Panama Canal is nearing completion, a number of American workers will be ripe for a change of scene. They have been receiving good wages and will have money in their pockets. It is probable that the love of travel and change will lead some of them to South America; in this connection a word of warning is due.

I am writing from Colombia—the country nearest to Panama—a country which is, in popular belief, the El Dorado of miners; a country in which several railroads are in operation and in course of construction; and one which has recently come into notice in connection with oil and other concessions.

The American or European firms operating in Colombia usually engage white employees from home, under contract. There is therefore small chance for the man who casually drifts into camp. One difficulty is the extent of the country—more in difficulty of travel than in actual miles. A man on first landing at Barranquilla or Cartagena finds workmen who do not object either to hard work or long hours, earning from 40 to 60 cents a day. He learns that up country are mining camps staffed with white men, and probably decides to try his luck. The only road is on the river Magdalena, on steamboats traveling about six miles an hour. When the moon is full these boats travel (or may travel) full time; at other times they often tie up to the bank during the dark hours. The journey may therefore take four days or more than a week. On leaving the boat a spot is chosen where a feeder railway runs something less than a hundred miles into the country, and from there travel is over roads such as are unknown in the wildest of the northern Rockies. Local transportation is on mules, but this is expensive for a man who is not a native, probably with a slight acquaintance with the language and not conversant with the customs of the country. He will soon learn one custom which is prevalent though not universal, the habit of charging foreigners double what is charged to a native. The mining camps may be fifty or more miles apart, or several days measured by time of travel, over roads which are a succession of steep climbs or descents, in a country of perpetual summer heat, the only division of seasons being wet and dry. At the camp he finds the usual men under an agreement from home. If he is an artisan, a blacksmith or carpenter, he may get work at something slightly under a dollar a day. This is enough to live on, but not enough from which to save a stake with which to reach home. If he is unsuccessful he drifts to the next camp, there to repeat the experience.

The native Colombian is a very adaptable man, and he is clannish. Therefore we find the railroads manned by natives and little chance (as there is said to be in the Argentine) for American engineers.

I have been prompted to this warning because the procession has already commenced. Men are reaching this camp at the rate of one a month. So far they have been entertained for a day or two and helped on their way. This is not pleasant for men anxious for work, and if the stream increases the scattered camps will not feel able to do as much as they do now.

It should not be overlooked that the tendency in seeking work is to drift farther into the country, and that the difficulty of working back to the coast is great.

A man "on his uppers," willing to do "anything," has not the scope which he has at home, for good labor is content with 50 cents a day. I have miners working at this figure, and the work is much sought after. They work from six to five, often up to their knees in water, with only forty minutes for rest and food, under a hot sun. And it is actual hard, muscular work.

Colombia is a country of great resources and many possibilities, and far from fully developed. There are openings here, but there are more openings anywhere in America. And an American from Panama is not likely to wish to settle here in one spot to slowly and laboriously carve out a mere "good living" for himself.

From inquiry—not from personal knowledge—I gather that Venezuela is on a par with this country. Of the other South American countries I know little. But before taking a journey south an American worker will be wise if he obtains from some reliable source particulars of the conditions prevailing in the country he thinks of visiting.

W. E. WARD.

Medellin, Colombia.

A Problem in United States Coins

To the Editor of the SCIENTIFIC AMERICAN:

Here is a little problem in figures that may be of some interest to your readers. Having for many years handled the shipments of coin from this mint, I have observed many combinations. The following however is most peculiar and will give your readers something to work over. Perhaps some of your readers would give an algebraic formula for the solution. How can 200 coins of the United States (present coinage) be so divided as to total $500. Every coin must be used at least once. Coins now minted are 1-cent, 5-cent, 10-cent, 25-cent, 50-cent ($2½, $5, $10 and $20 gold).

THEODORE L. DELAND, *Shipping Clerk*.

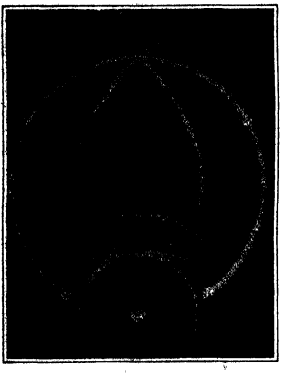
United States Mint, Philadelphia, Pa.

Halos and Sundogs

To the Editor of the SCIENTIFIC AMERICAN:

On the second day of November, 1913, there was manifested in the sky a very complete set of halos and sundogs. They were seen here in Richmond and probably in a considerable area, for several inquiries were received by the railway companies from their station agents out on their lines as to the cause of the phenomena.

I first noticed the phenomena about noon, and they remained visible several hours. The most marked object was a large circle about thirty degrees above and concentric with the horizon. It was white and about the width of the full moon. On this circle there were four bright chromatic nodes, marked on the accompanying drawing *A*, *B*, *C*, *D*. About the sun there was a marked but not unusual halo strongly chromatic at the point *E*, and gradually fading away toward each side as shown. There was a second concentric circle at *F*, also chromatic. From the point *E* tangents extended out on each side as shown. Perhaps the most unusual part of the picture was the lines *IG* and *IH*. They were white, about the same width as the large circle, and very clearly seen from *I* to *G* and *H*. Beyond *G* and *H* they became very faint, but seemed to curve in to the point *E* as shown. On the attached sketch *S* represents the sun and *O* the zenith.



A complete set of sundogs and halos.

I suppose all these phenomena are due to the refraction of light from minute particles of water or ice in the higher atmosphere, but the detailed explanation of how such peculiar lines as *IG* and *IH* as well as the tangents at *E* are produced is beyond me.

The day was beautiful, an ideal autumn day; cool and clear with a slight haze in the air and a bit of herring-bone effect in the sky at times. There were no clouds except very low down, and the geometrical designs traced in the sky were very striking. With some crude instruments Dr. Hopkins and I measured the angles as best we could, and the drawing is fairly accurate.

I shall be pleased to have you make such comments and explanations as you may wish.

Richmond, Va. E. C. L. MILLER.

[Dr. Miller may congratulate himself on having seen a most striking and rare phenomenon. On November 1st and 2nd, 1913, a large area of high barometric pressure—an anticyclone—was drifting sluggishly across the eastern half of the United States. Over extensive regions of the country the sky was lightly veiled with cirro-stratus cloud. Evidently the air at this cloud level was in a very unusual state of tranquility, making possible the occurrence not only of the common varieties of halo, which do not depend upon any particular angular position of the ice crystals in the atmosphere, but also those rarer halos which can occur only when the crystals are falling in a horizontal position. Complicated and beautiful halos were seen at many places in the States of the Mississippi Valley on the 1st, and in the Atlantic States from Maryland southward on the 2nd. The phenomena appear to have reached a particularly high state of development in southern Virginia, though those seen the previous day at points in Missouri and Arkansas were no less remarkable.

The lines marked *IG* and *IH* in the drawing, known as the "oblique arcs of the anthelion," are especially rare. The theory of these arcs has never been satisfactorily worked out, though they are supposed to be connected with striations on the faces of the crystals.

The nearly horizontal arc tangent to the lower halo at *E* is the "upper tangent arc of the halo of 22 degrees." With increasing altitude of the sun above the horizon the ends of this arc bend downward until it finally becomes an ellipse surrounding the 22-degree halo. It is then called the "circumscribed halo" and was seen in this form at several places on the dates in question.

All the halo phenomena shown in the drawing, and many others, are described in Mr. C Fitzhugh Talman's article "Solar and Lunar Halos," in the SCIENTIFIC AMERICAN SUPPLEMENT of November 16th, 1912.

It seems probable that if all the observations of the halos of November 1st and 2nd should be collected it would be found that some observers were treated to sights rivaling the historic "Petersburg phenomenon," of 1790, which has heretofore ranked as the most wonderful halo ever seen, except, perhaps, in the polar regions, where complicated halos are fairly common

We take this opportunity of thanking other correspondents who have sent us reports and drawings of these halos.—EDITOR.]

Positive and Negative Natural Laws

To the Editor of the SCIENTIFIC AMERICAN

In reading the editorial, "Positive and Negative Natural Laws," volume cx, No 2, I was impressed with the fact that the principles therein stated work out very well in our everyday life.

The good that is to come, the profits which are to result from working for a cause, for standing firm in tight corners, are not always evident. There is no positive law which says that there is a satisfactory reward for every worthy effort, credit for a scientific discovery may never be given to the right workers, the probable results of any particular research cannot always be foretold, or again there is no certain benefit which is positively obtained by all who respect and use natural laws.

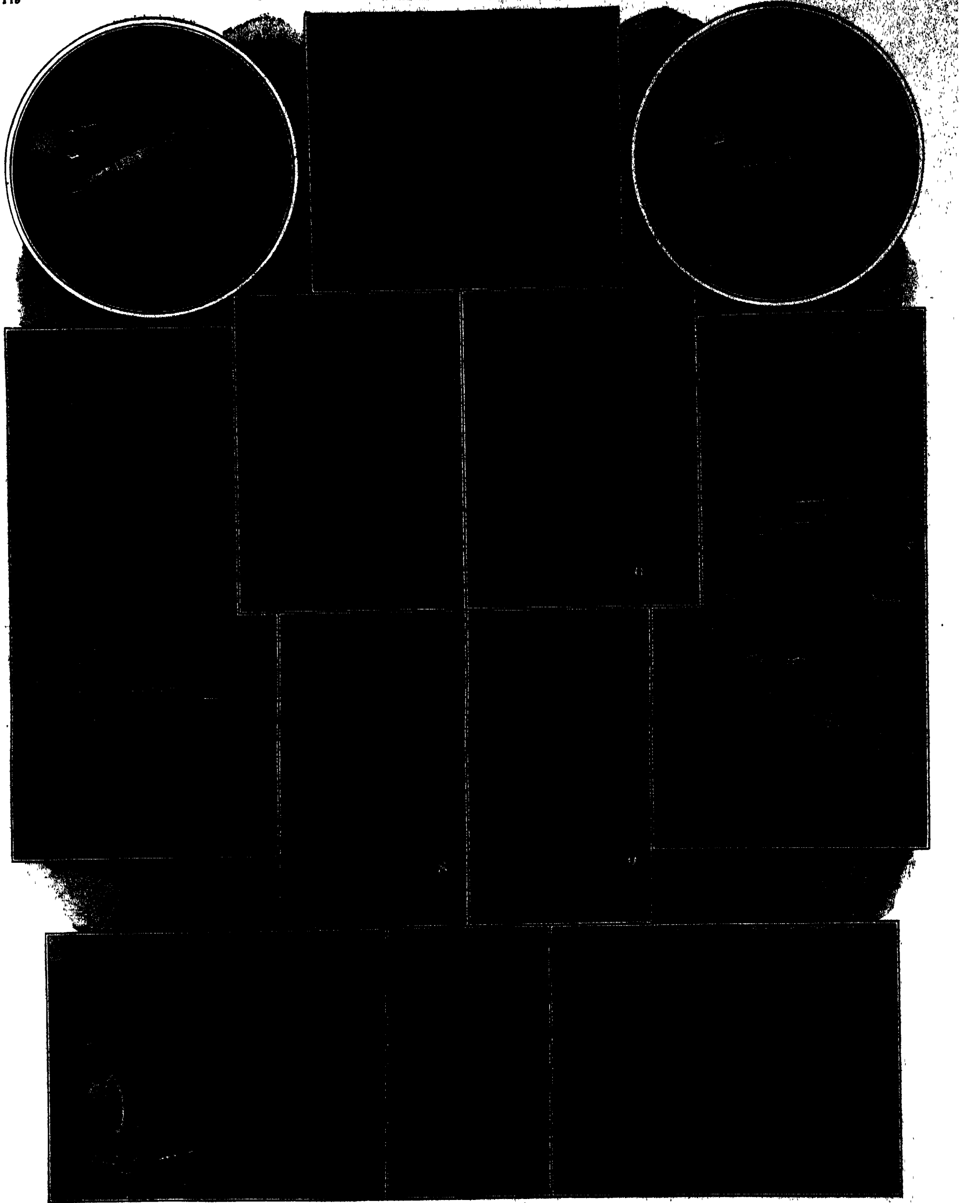
The negative causes and results, however, seem obvious. The losses, hardships, or difficulties are certain to arise from not guarding an exposed belt, not disclosing a useful discovery, not respecting natural or approved artificial laws, not conserving national resources, or other negative conduct. We do not know what electricity is, yet we are not ignorant of its existence, laws, and uses. Even the commandments are negative admonitions Certain it is then, that negative laws are of universal application; they are in fact often more powerful and useful than positive statements would be.

PHILIP E. EDELMAN

Minneapolis, Minn.

Earthquakes and the Panama Canal

DR. CHARLES DAVISON, the leading English seismologist, discusses this subject in the *Geographical Journal*, and comes to conclusions almost as reassuring as those reached by Mr. D. F MacDonald in his article in the SCIENTIFIC AMERICAN of October 18th, 1913. He gives three reasons for thinking the danger from future shocks to be slight, viz., the fact that only three earthquakes, including that of last October, have attained even a semi-destructive character in the present Canal Zone since the time of the Spanish conquest; that, as pointed out by Mr. MacDonald, the canal is remote from mountain ranges and does not traverse any important faults, so far as known; and, lastly, that even if a violent earthquake should occur it would probably have no more disastrous effect on the canal than to cause landslides from the sides of the cuttings, as the researches of Milne, Sekiya and Omori have proved the destructive vibrations of earthquakes to be confined chiefly to the surface of the ground and to extend only in a slight degree to the bottom of a deep artificial excavation. All three arguments are, however, qualified; the first by the fact that violent quakes have sometimes occurred in regions previously exempt (e. g., in the Colchester district of England, in 1884, and at Charleston, S. C., in 1886); the second by the fact that deep-seated faults, capable of giving rise to severe earthquakes, often exist in places where the surface conditions give no indication of their presence; and the third by the consideration that landslides caused by a violent earthquake, if they should occur after a prolonged period of heavy rain (a very probable event on the Isthmus), might themselves constitute a serious calamity.



1. This picture shows the method of instructing employees adopted by the New York Central Lines. It illustrates the improper way of using a jack without proper blocking. Thus used, a jack is apt to slip out and cause injury to the man using it.

2. Climbing over drawbars of cars to save walking around. A dangerous practice, since the cars are apt to be moved without warning. (New York Central Lines' method of instructing employees.)

3. Contrast this picture with picture No. 1. It shows the proper use of a jack with blocking at the top and bottom. Bolts run through the cross grain of the blocking to prevent it from slipping. (New York Central Lines' method of instructing employees.)

4. Flagging his train. The third rail makes a comfortable seat, but who protects the train? (The Pennsylvania Railroad Company's method of instructing employees.)

5. A common practice which is extremely hazardous. The employee is standing between the rails and getting on the foot-board of a locomotive as it approaches. Contrast this picture with No. 6. (New York Central Lines' method of instructing employees.)

6. Contrast this picture with No. 5. It is safer to stand outside of the rail on the engineman's side, where there is less danger of serious injury if the employee misses his footing. (The New York Central Lines' method of instructing employees.)

7. With rubber blankets the repair man guards his body or tools from coming in contact with the third rail. Exhibited by the Pennsylvania Railroad Company at the Safety First Exposition.

8. It is not necessary to go between cars in order to couple them. This is the wrong way. (The Pennsylvania Railroad Company's method of instructing employees.)

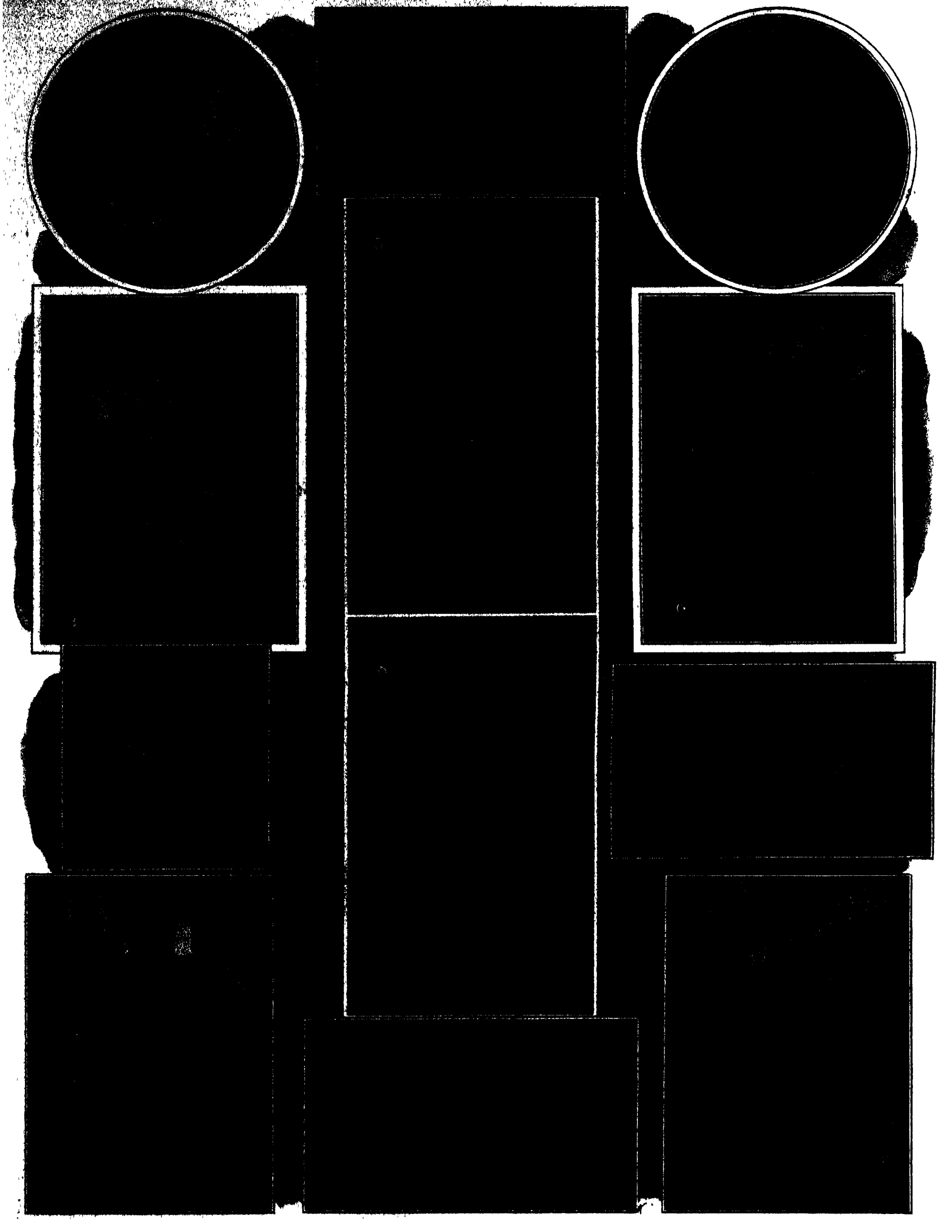
9. This is the right way of coupling cars. Contrast with No. 8. (The Pennsylvania Railroad Company's method of instructing employees.)

10. The Ferguson double derailing track target, used at the National Tube Company, Lorain works of the United States Steel Corporation. The picture shows the position of derailer when the car is approaching. The device is made double so that it may be fastened to either rail and afford protection from either direction. The word "outside" in cast letters indicates the proper position of derail when attached to rail.

11. This man takes his life in his hands. A slight jar might throw him to the tracks. (The Pennsylvania Railroad Company's method of instructing employees.)

12. Contrast this picture with No. 10. The Ferguson double derailing track target. The front trucks are completely off the rails with derailer still in place.

Safe and unsafe practices in railroading.



1. Gates swinging outward over a footway used by children in going to and from school. (Copyright, 1918, by the United Gas Improvement Company, Philadelphia, Pa.)

2. In the foundry of the New Jersey Zinc Company casting chippers use goggles.

3. The box covering the fire hose is so located that the streams cover the maximum number of buildings and the hose is carefully inclosed, but the real handle projects, so as to render serious injury to a passer-by imminent. The hazard was disposed of by disconnecting and hanging the handle under the box. (Copyright, 1918, by the United Gas Improvement Company, Philadelphia, Pa.)

4. The Benjamin safety device for stamping presses necessitates the removal of both hands from the point of danger, to trip the press before the ram starts in its downward direction.

5. The danger accompanying unlocked elevator counterweights. The valve was so located on the pump that the head of the workman adjusting it was brought directly under the counterweight and struck. Contrast this picture with No. 8. (Copyright, 1918, by the United Gas Improvement Company, Philadelphia, Pa.)

6. Guard for slotting machine in the Brown & Sharpe works. The swinging guard has a hole so that the workman may see the operating parts and still be protected.

7. Employees entering the building in a hurry formerly took the short cut over the side of the porch and in several instances injured their heads in the manner illustrated. As indicated by the dotted lines, the railing forces the employees to enter at the front of the porch. (Copyright, 1918, by the United Gas Improvement Company, Philadelphia, Pa.)

8. View of the location pictured in No. 5. A wire guard is so placed that there is no danger of a workman's being caught by the counterweight. An excellent illustration of how satisfactory guards may be made at home at very little cost. (Copyright, 1918, United Gas Improvement Company, Philadelphia, Pa.)

9. This picture shows a buzz-saw guard which was invented by one of the employees of the United States Steel Corporation. When the saw is not in use, the guard hangs down and completely covers the blade. When a board is started the guard rises against the springs *CC* and also turns on the joints *DD* and *EE*. When the board is sawed nearly through, the operator grasps the handle *F* and pushes the board through. His hands do not come near the saw.

10. Lead wires in a passageway back of oil switches. Similar hazards may be found in many offices where connecting cords of electric fans and office machines are left lying on floors. (Copyright, 1918, by the United Gas Improvement Company, Philadelphia, Pa.)

11. This illustration, exhibited at the recent "Safety First" Exposition by the Pennsylvania Railroad, shows the extreme carelessness of an employee seated on a can of gasoline.

12. Safety switch in the foundry of the Brown & Sharpe works. The truck is prevented from running off and falling on the workmen when the switch is open.

How some very common accidents are caused.

Four-Gun Turrets of the French Battleship "Normandie"

A Notable Experiment in the Mounting of Heavy Ordnance

TIME was in the French navy when the authorities favored the placing of only one gun in a turret. Theoretically, so far as the rapidity and accuracy of gun fire are concerned, that was the ideal arrangement. But French naval authorities are distinguished for the great variety and suddenness of the changes which they introduce. To-day the pendulum has swung to the other extreme, and in the four latest dreadnoughts, the "Normandie," "Gascogne," "Languedoc," and "Flandres," the French are putting four guns in a single turret—and this at a time when the two leading naval powers, Great Britain and Germany, are still using only two guns per turret.

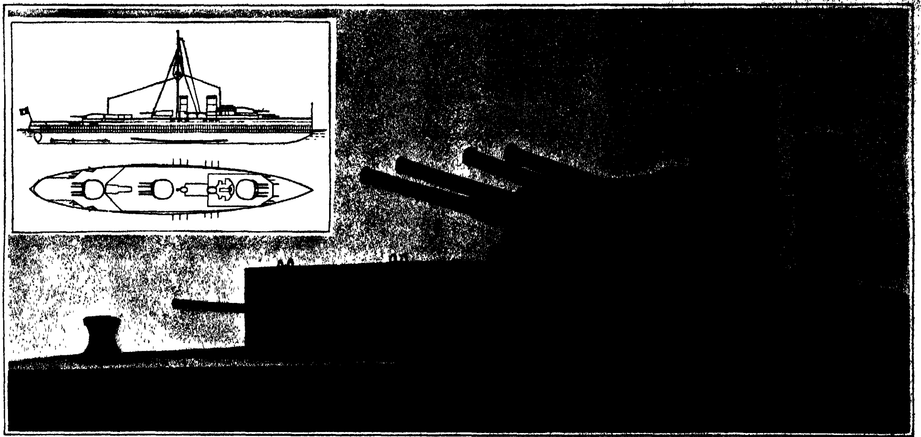
The "Normandie" class are big ships, 574 feet long, 92 feet beam, 28¼ feet maximum draught, and they displace 25,387 tons. The armament is heavy, consisting of twelve 13.4-inch guns carried in three four-gun turrets. The foremost gun is carried above a superstructure on the forecastle deck, the axes of these guns being surely not less than 36 feet above the water line. Amidship above the spar deck is the second turret; and aft above the main deck is turret number 3.

The 13.4-inch gun is a powerful weapon, 45 calibers in length and firing a shell weighing 1,433 pounds, which is slightly heavier than the shell of our 14-inch guns, with a velocity of 2,657 feet, which is slightly greater than that of our 14-inch piece; so that although of *less bore, this French gun must be of somewhat greater* power than ours.

The advantages of the four-gun turret are that there is considerable saving in weight of armor and gun carriages, and of ammunition lifts and gun-operating mechanism. Also it conduces to good shooting, for the reason that four shots fall in one place, and the work of the spotter is facilitated. It is believed that the guns are not mounted in one sleeve, but in pairs in two sleeves; but possibly the two sleeves are connected to a common elevating mechanism, in which case all the advantages of a single sleeve are secured. The theoretical disadvantage of the four gun turret is that a single heavy armor-piercing shell, penetrating such a turret, may put four guns out of commission at once.

These ships are heavily armored, carrying about 13 inches on the belt, 17½ inches on the main turret, and 10 inches on the sides of the ship above the main armor belt. The secondary battery of twenty-four 5.5-inch guns is carried as follows: Six in a battery protected by 8¼-inch armor, situated forward of No. 1 main turret, on the forecastle deck, these six guns being capable of fire dead ahead; twelve guns placed in broadside on the main deck between turrets Nos. 1 and 2 and behind 8¼-inch armor; and six guns carried on the gun deck abreast of and on the quarters of No. 3 turret. These positions are shown clearly in our deck plan of the ship.

These four vessels are to be turbine-driven on four shafts at a speed of 21.5 knots. They will be fired with coal and oil. The success of these four-gun turret ships will be watched with great interest in naval circles.


The "Normandie," one of four French ships, of 25,387 tons and 21.5 knots. Armament: Twelve 13.4-inch guns in three turrets, carrying 17½-inch armor; twenty-four 5.5-inch guns, protected by 8¼-inch armor.

The first battleships to carry four guns in one turret.

Fighting Grasshoppers in Uruguay

PEOPLE living in Kansas, Utah, and other parts of our great western plains have by no means forgotten the devastation and desolation caused by the vast hordes of grasshoppers which have swept over the country in former years. Similar pests have visited destruction on the north coast of Africa and on the rich pampas of South America.

Some recent successful efforts at fighting this plague are described in *Kosmos* by L. Geret of Antwerp as follows:

"As soon as the little creatures hatched from the eggs deposited in the earth by previous swarms are able to hop, and even before they can fly they exhibit the migrating impulse. The habitat of this Argentine plague is in the north, near the Bolivian boundary; from there the swarms overflow the rich provinces of Santa Fé, Entre Rios, and the Republic of Uruguay. In dry weather the insects lay their eggs *en route*, and pursue their career of destruction to a point south of Buenos Ayres, soon after which they expire. By January the swarm issuing from the eggs has reached maturity. . . . When at a given time all the "hoppers" of a locality set themselves in motion toward the same direction is the moment chosen for fighting them by the ancient method of the country. Sheets of tin are bound together so as to stretch continuously for many kilometers, forming barriers whose smooth sides it is impossible for the insects to scale.

"Every tree near this tin barrier is likewise provided with a tin 'cuff' to prevent its being used as a bridge. The current is checked at the barrier and begins to flow along its side. Near the barrier at spaced distances deep holes are dug and surrounded by tin barriers placed at such an angle as to form a diminishing passageway or conduit to the mouth of the hole, into which the stream of insects flows steadily till it is full. As each hole is filled it is covered with earth and stamped down and fresh holes are made.

"Naturally only a small proportion of the insects can be destroyed by this simple means. The others increase in size—many reach a length of 8 centimeters and rise into the air like a dark cloud and fly away to seek food. One evening, at Fray Bentano's on the Uruguay the writer helped frighten away a swarm which had even from afar the threatening aspect of the smoke from a conflagration, had then flown over the river, 7 kilometers wide at this place, and was about to settle on the beautiful flower-decked gardens of the casino of the Liebig Company. With hastily concocted banners, with whistles, trumpets, bells, tin-pans, fire-locks, a deafening gong, and an unearthly pandemonium, the great body of the hungry swarm was driven away to fall on more distant fields. Yet enough of them remained with us to rob many a tree of its crown of leaves, and the procession of the flying insects seemed almost interminable, offering a noteworthy spectacle. . . . The extent of such swarms in flight has been estimated to be at times dozens of kilometers in length and many kilometers in breadth.

"An indefatigable investigator of the Pasteur Institute in Paris, Felix d'Herelle, has succeeded by the artificial propagation of an insect-disease in almost annihilating the most formidable swarms of this pest in the Argentine. During a stay on the Yucatan Peninsula in 1910 this well-known bacteriologist studied a malady then raging among the grasshoppers there. Dr. Roux, the director of the Pasteur Institute, presented the results of his observations before the French Académie des Sciences.

"According to this report a certain bacillus (*coccobacillus acridiorum sp. nov.*) has such an effect on the grasshoppers that they perish within [illegible] hours. The intestinal content of the insects is then found to be an almost pure culture of the bacillus. M. d'Herelle expressed the opinion that the insects could be exterminated by any artificial spread of this 'epidemic.' M. Gallardo, the director of the National Museum of Buenos Ayres, was staying in Paris at the time, and induced the Argentine Bureau of Agriculture to invite the French investigator to test his process practically in South America. M. d'Herelle accordingly caused a swarm of grasshoppers in Santa Fé to be surrounded by a palisade in order to study the effects of his epizootic cultures within the inclosed space.

"These culture of bacilli were dissolved in water and sprinkled over a small portion of the maize which the insects had begun to devour. The malady spread with extraordinary rapidity. By the end of two days dead grasshoppers were found in every corner of the field of experiment; after the sixth day there were none left alive.

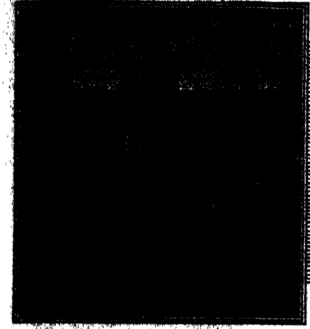
"Experiments on a large scale were attended by a like success. One liter of the culture liquid was spread over a field. After 5 days countless dead insects were found over the whole extent of the field of 25 hectares. The fatality continued on following days and spread through the vicinity. The speed with which the malady spreads is amazing. Only a few days after the start of the infection it was found to have extended to [illegible] kilometers distance from the original spot, being in every case carried by the winged insects, which are capable of covering 30 kilometers in a day.

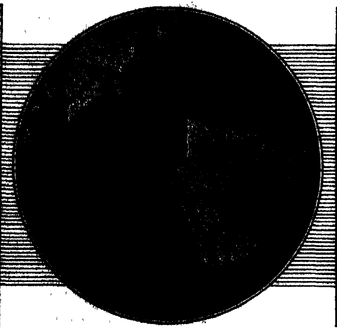
"Other varieties of grasshoppers were also attacked by the disease, so that the hope is justified that it will prove an effective agent against this terrible plague in other localities."

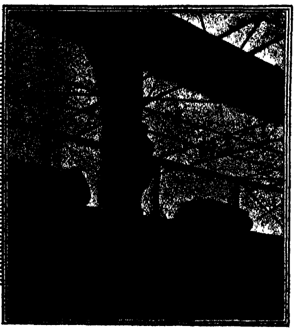
Safety in Steel Works

The Scientific American's Associate Editor Sees How Employees Learn Caution by Hunting Dangers

By A. Russell Bond


The crane man used to have to climb up the lattice work to his cab.


Railed stairways and platforms with safety treads now lead to the crane cab.


The first attempt at safety for the crane man was a wooden ladder.

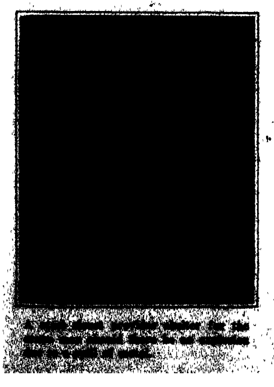
ANYONE who thinks that the safety movement of which we hear so much these days consists merely in an agitation for the adoption of safeguards and "fool-proof" machinery, is far behind the times. Probably that individual also thinks that the "fool" against whom the machine must be "proofed" is an ignorant foreigner. But that is another mistaken notion. The man who gets hurt is the careless man. He may be careless by nature or by design, and to neither of these classes does the foreigner belong. The very newness and strangeness of his surroundings makes him cautious. The man who makes the most trouble, not only for himself, but for his fellow workmen, is the one who thinks it smart to take a chance, the one for instance who does not consider himself or his fellow a good railway man unless he can stand between the rails before an approaching locomotive and step upon the footboard just as he is about to be struck. He is a good sport and takes a chance on what he feels is a pretty sure thing. Nevertheless, it is a game of chance and stakes are very high.

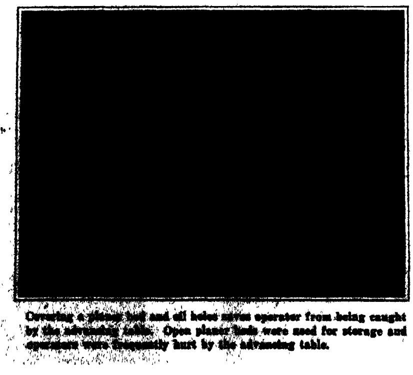
A man of such disposition is most ingenious in devising methods of self destruction or injury, and the mere provision of safeguards cannot cope with his propensity to mischief. Something must be done with the man as well as with the machine, and so now the more progressive safety organizations lay great stress on educating the careless employee to a new attitude toward the dangers that inevitably lurk about him. The best way to learn a thing is to teach it. Hence, it is the custom to make safety instructors of the men themselves, as in that way they will learn what the safety movement is, and how best it may be furthered.

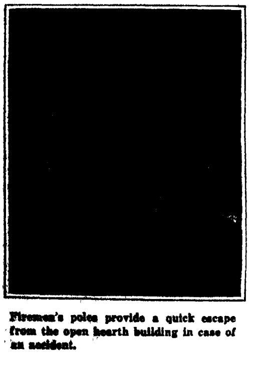
An excellent illustration of this method may be found in the organization of the United States Steel Corporation. The safety idea permeates the whole organization from the highest official down to the workingmen themselves. First of all there is the Steel Corporation Safety Committee, consisting of an officer of the Steel Corporation as chairman and seven other members representing the largest subsidiary companies. This committee meets quarterly to study serious accidents and makes recommendations against further occurrences. It conducts its inspection by having an inspector of one company inspect the other company's operations. All the inspections are made personally. Second, there are central safety committees of the subsidiary companies, made up of important officials from each of the plants, mines or railroad divisions, which conduct inter-mill inspections and meet monthly for conference and recommendation of safety devices. Third, there are plant safety committees which meet monthly, weekly, or in some cases daily. Fourth, there are the department and special committees, made up of foremen, master mechanics and skilled workmen, who meet weekly or monthly as the case may be. And finally, there are the workmen's safety committees, usually made up of three members of the rank and file of the mill. These members are changed periodically, so that eventually every man in the works will at one time or another have held a position on one of these committees.

During the year ending December, 1912, 4,678 men served on the various committees, and probably the greatest service was done by the last two committees, because they were made up of those men who were studying their own personal risks, trying to find trouble before trouble found them. It is the policy of the company to encourage the men to make suggestions by means of rewards. As an illustration of the value that is attached to the employees' own recommendations, we may take the case of the guards placed over circular saws. When the foreman of the shop is informed that he must place a guard over the saw and a certain standard type of guard is recommended to him, he is quite apt to look with contempt upon the device and criticise it as being of little value. "All right, John," says the safety inspector, "you are an ingenious fellow. Why don't *you* get up a safety device that is *really safe*?" And so John thinks the matter over, and in a day or two suggests a design for a new guard which the safety inspector praises highly and is glad to accept; for although the device may not be as good as the one originally recommended, it will be scrupulously used, and the foreman will see that all the men under him use it too. Far better is a poor device faithfully used, than a good device employed under protest. But the result of this policy of letting a man build his own safety device has resulted in the designing of some very clever apparatus. With the ordinary guard there is nothing to prevent the operator from having his thumb cut off as he follows up the work to the saw. One ingenious foreman, realizing this defect, provided the bottom of the saw guard with teeth or notches, by which the work could be pushed up to the saw. This safety device is illustrated on another page.

The writer recently had occasion to visit the works of the Illinois Steel Company at South Chicago, and was struck by the "safety first" atmosphere that pervaded the whole works. Safety signs in five languages were set up at all points in the works where there was a possibility of accident. Not only that, but the men themselves seemed imbued with the safety spirit and enthusiastic in their support of safety methods. Last spring an accident occurred in one of the open hearth buildings, which illustrated not only the efficiency of the safety precautions provided against such an accident, but also the spirit of the men. A huge ladle containing fifty tons of molten metal was being taken down the building by means of a traveling crane. One of the bearing boxes of the winding drum of the crane broke, causing the drum shaft to tilt and throw the gears out of mesh. Immediately the tackle on one side of the ladle slacked away, permitting the molten steel to pour out upon the floor below. A spill of this sort


A [illegible] shelter for the [illegible]


Covering a planer bed and all holes saves operator from being caught by the advancing table. Open planer beds were used for storage and operators were frequently hurt by the advancing table.

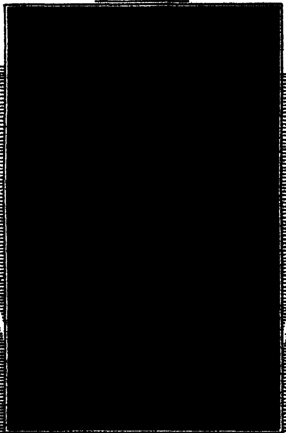

Firemen's poles provide a quick escape from the open hearth building in case of an accident.

is invariably attended by an explosion, and not a second must be lost in jumping out of the way to avoid being burned to death. To provide for just such an emergency, the outer wall of the building had been provided with window openings all along the pouring level, and these windows were protected on the outside by means of wooden hoods Four or five men were on the pouring platform when the accident occurred, and immediately they leaped to safety through the opening. (See our cover illustration.) The crane man also was in immediate danger and had to act instantly. There was not even time to stop the crane. He leaped for a ledge above the craneway and dodged through one of the many windows provided for just this purpose, to a runway at the outside of the building. It was a narrow escape; but the crane was still running down the mill, pouring out a stream of liquid fire, and if it were not stopped, would soon reach a number of men who were at work in the "pit" with no chance of escape; also if the crane continued, it would eventually strike the end wall of the building and doubtless go to smash or destroy the wall. Mindful of these dangers despite his own harrowing experience, the crane man ran along the runway outside of the building until the first flare of the explosion had subsided. Then he dodged through one of the windows ahead of the crane, jumped into the cab as it came along, and brought it to a stop His presence of mind saved many lives and valuable property. He was rewarded by a "safety first" banquet and a raise of pay Although the men who were on the pouring platform did not hesitate an instant to take the leap, nevertheless after they had undergone the experience, they realized that a jump into space required some courage and was not without danger. Accordingly, one of them recommended that the openings be provided with firemen's poles, down which the men could slide. This recommendation was immediately adopted, and one of the accompanying photographs shows how the hooded openings now look with the pole equipment.

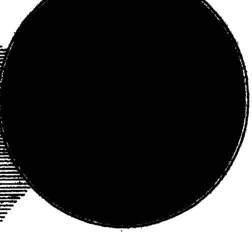
A funnel on the mouth of the "mud gun" prevents chopping off of toes and heels.

The windows of the saw-tooth roof are safely cleaned from the trolley that runs all around the building.

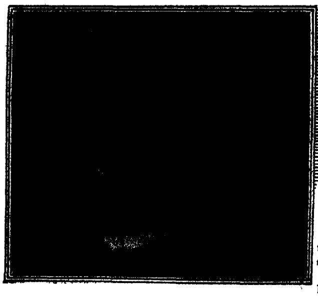
A handle on the hook saves the fingers.



Castings are broken up with a skull cracker picked up by an electromagnet and dropped upon them. To stop flying fragments a stockade of pipes filled with concrete has been set up. The value of this stockade is shown by the dents in the pipes.



This hook will not release when cable is slack.



These gears used to be uncovered and were a constant menace.

Now the bevel gear is almost completely inclosed in a sheet steel casing.

So sudden is the explosion from a tipped ladle, that sometimes the crane man has no opportunity to dodge out of the building. Accordingly the cabs are provided with steel compartments in which the operator of the crane may shut himself for protection against the intense heat. This gives him a chance of escape unless the heat is so prolonged as to bake him inside of his shelter.

Ladles are usually tapped by withdrawing a stopper. Formerly the stoppers were suspended by an ordinary crane hook, but on a couple of occasions as the stopper was being lowered it struck on the rim of the ladle, and as it hesitated there an instant, the slack in the hoist cable allowed it to become unhooked. One of the employees suggested a "pig's tail" hook, which has proved entirely satisfactory, as it prevents the suspended load from going over the point of the hook. Another type of safety hook designed by one of the men has a handle at the back by which it may be operated without danger of catching the fingers between the hook and the load.

Hundreds of little devices of this sort have been developed by the workmen's safety committees. One of the illustrations shows an improved mud gun, developed at the works of the National Tube Company in Lorain, Ohio. It is a machine with which balls of clay are packed into the tapping hole of the furnace to close it after the furnace has been tapped. The clay balls are dropped through a hole in the casing of the gun in front of a plunger which [illegible] opening. It used to be that if a clay ball [illegible] in the hole, the operator would push it down with his foot. As a result many a heel or toe was cut off by the plunger because the man pushed his foot in too far. To overcome this, a funnel is placed on the mouth of the mud gun, making it impossible for a man to push his foot in far enough to get it caught.

While the workmen supply many safety suggestions, most of them come from the official safety inspectors. Herewith is a set of three pictures from the Carnegie Steel Company's plant at Homestead, Pa., illustrating the improvements that have been developed in providing access to the crane cab. Originally the operator of the crane was obliged to climb the steel lattice work of the columns in order to reach his cab. This proved a dangerous practice and so ladders were provided, as shown in another picture. But this still required a man to be pretty much of a monkey in order to reach his cab, and eventually, steel stairways and platforms with friction treads were provided, so that a man could reach his crane cab in perfect safety. The platforms also are of use in making repairs upon the crane.

In a plant like that at Gary, Indiana, which has been built since the safety movement was started, safety provisions were made from the very start. But in the older plants an enormous outlay was found necessary to bring them up to present day safety standards. One of our illustrations shows a trolley for window cleaners

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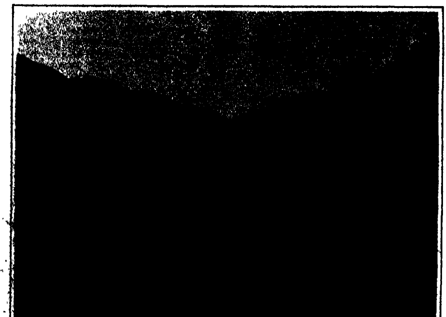
Let the Sun Supply Hot Water

T[illegible] on sunny days, but also, by means of a cleverly devised tank, will conserve the heat over a number of dark days. This is made possible by a packing around the tank similar to that in a fireless cooker. Not only hundreds of homes in the West are thus equipped, but a number of public buildings, notably playground and school buildings, in California make use of this system to supply hot water for shower baths without cost. After the plant is paid for, there are no further charges. The photograph shows one of the largest of these public installations, a 500-gallon tank heated by three night-and-day solar heaters on the roof of the playground building in Exposition Park, Los Angeles. The "chimney" on this structure is in reality a screen for the tank, which is set upright in the attic, projecting through the roof. The heating coils of galvanized iron pipe are in the three glass-covered boxes, exposed on the southern face of the roof. These are connected with the tank, which in turn connects with the showers. No artificial heat is needed. For use in the Eastern States, the system is available the greater part of the year, while in winter the heater coils are drained to prevent freezing, and an auxiliary piping system that joins the furnace or other house-heating device is installed. Half a dozen playgrounds and four or five schools in California have been thus equipped recently, while the domestic installations have been in successful use for years. Even apartment houses have made use of this economical method of obtaining plenty of hot water at any hour of the day or night.

Solar heater on the playground building in Los Angeles furnishing hot water for shower baths.

The Highest Dam in the World

THE United States Reclamation Service is blocking the Boise River canyon, at Arrowrock, with a dam 350 feet high. This will be the highest dam in the world. It will have a length of 1,075 feet at the top, and will contain 530,000 cubic yards of material. During construction the waters are being diverted through a tunnel running around the dam. The tunnel is 487 feet long and measures 25 by 30 feet. It is large enough to pass the whole of the Boise River. The accompanying photograph shows the water pouring out of the tunnel. On the right, near the top of the picture may be seen the excavation for the spillway, which shows to what a height the dam will be carried.



Building the Arrowrock dam across the Boise River; the highest dam in the world.

German Gasoline-Electric Road Train

By Our Berlin Correspondent

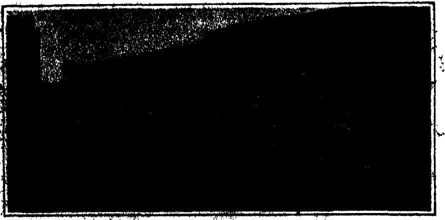
A REMARKABLE gasoline-electric road train has recently been introduced in Germany which comprises a power car and ten trailers each of 5 tons capacity.

The power car carries the generator set, viz., two Daimler motors of 125 horse-power each, driving a dynamo installed in the center. The current is transmitted to the electric motors actuating each of the wheels of the power car and trailers. The armatures of these motors are arranged in parallel, and the inductors in series; the former derive their current from the main dynamo, whereas the latter are fed from an exciter machine which at the same time serves to excite the main dynamo. The field regulator of the main dynamo controls the tension of the armature, and accordingly, the speed of the train. A loop circuit allows a perfect uniformity of tension to be insured in all motor armatures. The motor fields are excited by a special "traction regulator," inserted into the exciter circuit, and the direction of travel is controlled by reversing the excitation of the motor fields.

The electric apparatus and instruments are arranged on the motor car, above the dynamo, so as to be readily accessible.

The steel rims of the wheels are 1.2 millimeters in diameter and 250 millimeters in width. Thanks to the identical construction of all the trucks, the number of exchange parts is reduced to a minimum. Chain transmission has been used to connect the trucks with one another, and the inside brakes formerly used have been replaced by outside brake shoes acting directly on the circumference of the wheels, thus greatly facilitating the superintendence of the brakes.

The weight of the power car in full working order is 9 tons, and of each trailer, 3 tons, or 39 tons altogether. The ratio between the carrying capacity and the net weight thus works out at 50 ÷ 39 = 1.3, which is 30 per cent more favorable than in the case of heavy load vans. The mean traveling speed is 12 kilometers (7.5 miles), and the maximum speed 16 kilometers (10 miles) per hour.



Gasoline-electric road train of 50-ton capacity.

How the Ostrich Rancher Travels

THE rancher in California or Arizona who goes into the business of raising ostriches can travel behind a team of these huge birds or use one as a saddle animal. The ostrich shows remarkable speed as a trotter, and a pair of them attached to a light sulky can make a mile in pretty close to two minutes. It will be observed that the light rig is equipped with a third wheel to take part of the weight from the team. The ostrich as a mount is almost as speedy, and carries a man easily.

Ostrich trotting team. Note the third wheel.

A Unique Emergency Power Plant

WHEN a manufacturing plant is confronted with the problem of replacing an old, inadequate battery of boilers with a new one of greater capacity, it is not a simple matter to make the change without interrupting operation.

This condition was met most ingeniously when it became necessary for a company of Philadelphia, Pa., making textile machinery and centrifugal hydro-extractors, to increase its source of power supply An estimate from the local company showed electric power to be of prohibitive cost. The idea of utilizing locomotives for the purpose, while novel, at first thought, bore the elements of sound judgment.

The location of the plant, on the main line of the Pennsylvania Railroad, made feasible the storage of locomotives on a long freight siding.

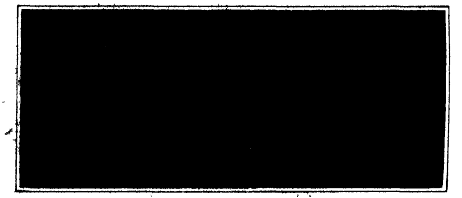
It remained a problem, however, to get locomotives of the proper capacity, for in these days of heavy railroading, small engines are rather difficult to obtain.

Two "American" type locomotives were finally obtained at a very reasonable rental. While they were doing service, the old battery of two boilers was replaced with a 462 horse-power boiler, stoker-fired by an automatic stoker of the five-retort type; the furnace is fitted with an extension grate, giving enough grate area to insure absolute combustion of the fuel, without having to have a brick arch

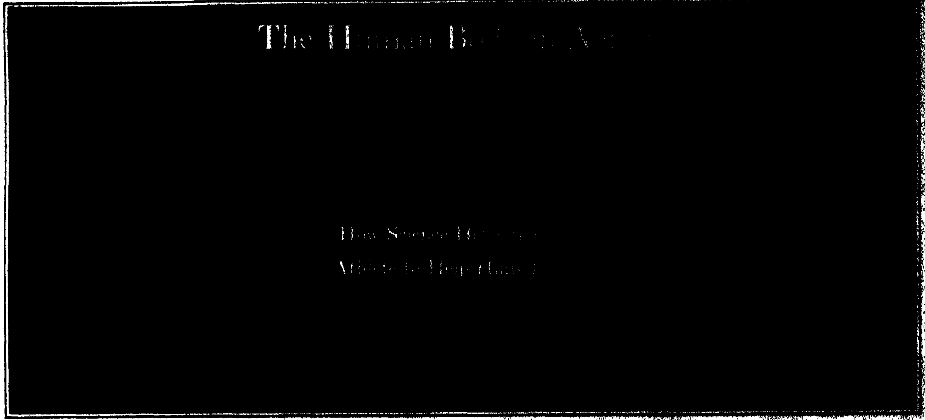
The process of locomotive boiler substitution was simple, but effective. The two old locomotives, whose connecting rods and valve gears had long been disconnected, were hauled to a convenient point on the siding, after their tenders had been uncoupled; their throttle valves were closed, and a connection piped from their auxiliary domes, over the fireboxes, to the main steam lines in the plant.

Their positions, back to back, with an elevated platform erected between them, allowed sufficient space for two firemen, and a coal supply that could be replenished without interrupting the service.

As a matter of fact, this means of steam supply is hardly economical enough to warrant its retention for a protracted period, since the amount of coal consumed per horse-power hour is far greater than the average manufacturing plant can afford; but there is no question that the money for the excessive coal consumption, in addition to the moderate rental, and a few dollars more for labor, are well spent when a continuous, liberal steam supply is assured, that keeps the plant in operation during the installation of the new boilers, and whose connection with the main steam supply can be made in a short time at night, without stopping operations



Two locomotives supplying a factory with steam while the boiler plant is being repaired.


The Human Body in Action
How Science Helps

The phases of a springboard acrobatic somersault.

EVER since 1896, the year in which the historic Olympic games were reinaugurated on a scale far grander than that conceived by the ancient Greeks themselves, there has been an unquestioned increase not only in the popular interest in athletics, but in scientific interest as well. In France physicists have applied scientific methods to the study of athletes in action with astonishing results. To be sure, this is nothing new. Years ago Muybridge published a series of photographs taken of men and animals in action, which are still regarded as classic in their way. But since Muybridge's day, apparatus and methods have improved, and it is now possible to record for future study athletic movements which it would have been difficult indeed to analyse twenty years ago.

Probably the foremost of Muybridge's successors is the distinguished Prof Marey, whose interesting and valuable work has been so frequently commented upon in the columns of the SCIENTIFIC AMERICAN. The accompanying pictures were made in accordance with his methods by Prof. Demeny. The apparatus used has been improved by Demeny and used by him at the French Academy for Military Sports in Joinville-le-Pont.

As our pictures show, the athletes are photographed, not upon a moving picture film a thousand or more feet in length, but upon a single plate. A black background is employed and the subjects are brightly illuminated, with the result that they are very sharply defined. The movements can be analysed into as many separate stages as may be desired, so that the result is not unlike a very slowly moving cinematographic film. Because the pictures are all taken upon a single plate, they lend themselves admirably for study and instruction. It is perfectly apparent that from pictures such as those which we publish, the athlete can learn much. He sees at once at what particular point of a movement he assumed an incorrect position, and why it is that he runs, walks, leaps, or fences inefficiently. Hence, photographs such as those which we reproduce have a very practical value. At the Joinville school, they are used to record and register the physical conformation and development of the pupils before, during and after training. The studies thus obtained are applied in choosing and instructing the gymnastic staff of the French army.

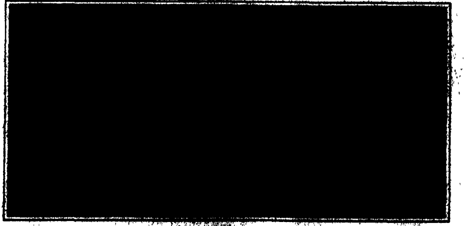
Any one of the pictures made in accordance with the Marey-Demeny system constitutes what may be called a "graph" or chart. It ought to be possible for an athlete to compare his photographic self, reproduced perhaps a dozen times on a single plate, with a standard "graph," and thus determine how he compares with a crack runner, fencer, or gymnast. "What am I doing wrong?" is a question that every athlete puts to himself. Even his trainer cannot always answer that question correctly; the movements are so very numerous and so very rapid that only the general effect produced can be criticised. In some games, such as in football or tennis or fencing, the timing of each movement is of vital importance. By studying photographs of himself, the player or fencer will learn, first, what is the minimum number of movements required and then the trick of making them in the minimum time.

It is obvious that the moving picture camera will accomplish much the same result as the apparatus of Professors Marey and Demeny. But on the other hand, a moving picture machine and its films are expensive. Besides, it is not easy to run a film slowly enough to enable an athlete to analyse his movements, because the highly inflammable celluloid of the film may catch fire if it is held too long before the electric arc.

Military Aeronautics in the United States

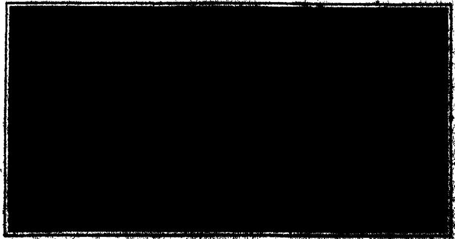
MILITARY aeronautics is extensively discussed in the report of the Chief Signal Officer, United States Army, for 1913, just published. This report emphasises a fact of which the public is probably not generally aware, viz., that the number of civilian aviators in this country is fast diminishing, and in the event of war at the present time it is doubtful whether a score of men capable of making flights useful to the army could be obtained from civil life. Hence, the urgent necessity of increasing the aeronautical branches of the army, navy, and national guard. The Signal Corps at present

A pole vault in all its more interesting stages.



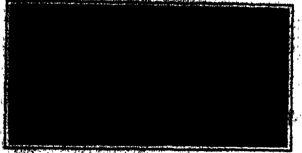
A hurdler in action.

The displacement of a fencer's body and arm during action, showing how a graph can be obtained.

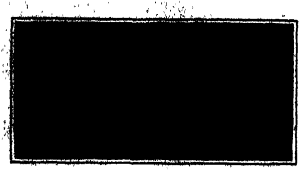


A standing broad jump made with the aid of dumb bells, showing how weights aid the athlete.

[illegible] twenty-three [illegible] ap- [illegible] 400,000, [illegible] 1912, [illegible] United States [illegible] artillery fire [illegible] found that it [illegible] and locate [illegible] in no other way. [illegible] probably by [illegible] of dropping [illegible] have been tried with [illegible] devised in [illegible] pounds and [illegible] miles. No [illegible] but this is [illegible] the prime requisite is to [illegible] the aviator's observations. [illegible] during the [illegible] located very [illegible] and their [illegible] photography, map-making and [illegible] have all been tried by our military aviators with [illegible] results. The Chief Signal Officer urges at length the claims of the dirigible balloon, heretofore almost completely neglected by our Army, and recommends a further increase in the pay of officers and men attached to the aeronautical branch of the service.

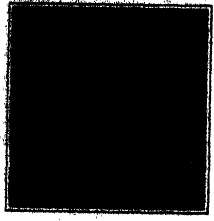


The player on the right has fumbled the ball.

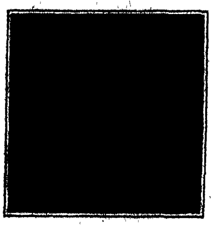


Composite photograph of a bad kick-off.

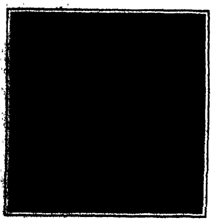
Composite photograph of a good drop-kick.



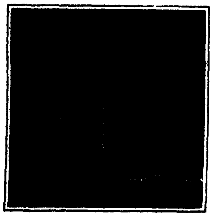
Study of a standing high jump from start to alighting.



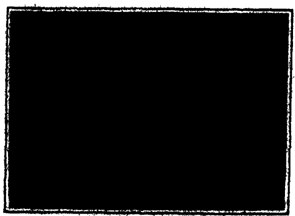
Composite photograph of a familiar calisthenic exercise.



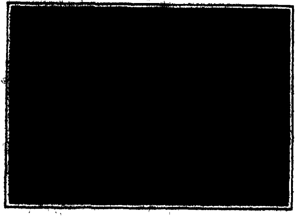
Study of an exercise for developing the abdominal muscles.



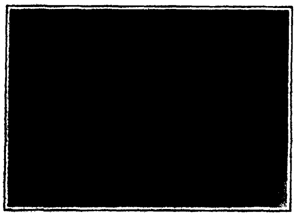
How an athlete jumps from a height to the ground.



Swinging between the parallel bars.



Seven stages of the giant swing.



Leaping over a gymnasium horse.

Spontaneous Combustion

THE term "spontaneous combustion" is generally connected in the public mind with coal, green hay or charcoal, but its application is much more extensive. One rather rare catastrophe often ascribed to this cause is the mysterious explosion of a flour mill. In reality this is due to the accidental spark ignition of an explosive mixture of flour dust and air. The mixture must be just right, yet once in a long time the dust-laden air of a mill meets the requirements and is ready for a spark from the machinery to start the trouble. [illegible] of dust in the region of the spark [illegible] almost instantaneously, and an explosion results.

[illegible] coal dust in air can be exploded with [illegible] as was shown by the recent Pittsburgh [illegible] of the Bureau of Mines.

[illegible] that spontaneously [illegible] when exposed to the air—or oxygen—and the [illegible] difficulties are annoying. Zinc [illegible] and another even more spectacular is "pyrophoric iron"—pure iron dust prepared by the reduction of iron oxide in an atmosphere of hydrogen. This curious variety of iron is sealed in the glass tube in which it is prepared—free from air—and when the tube is broken the instant combination of the iron and oxygen is accompanied by a flash of flame.

Of vastly greater concern to the public is the spontaneous combustion of coal. In large masses coal slowly unites with oxygen, producing some heat, and if this heat is not rapidly conducted away it acts as an accelerator to further oxidation. Since raising the temperature 18 deg. Fahr. doubles the velocity of most chemical reactions one can appreciate the cumulative effects of oxidation in large masses. In a small pile of coal this heat is slowly developed and radiated so readily that no rise in temperature is noticed. In a large pile of densely packed coal, however, radiation is restricted so that the temperature rises and, under favorable conditions, reaches the ignition point.

Coal dust exposes more surface than the same weight in lumps, so it is a source of danger, especially when mixed with lumps in such a way that air passages extend into the interior of the mass. When this circulation of air in the pile is just sufficient to support the oxidation, but not enough to carry away the heat developed, spontaneous combustion results. The Bureau of Mines sent out 2,000 letters of inquiry to large coal consumers of the United States, and out of 1,200 replies, 200 reported cases of spontaneous combustion. A great many such fires have occurred in the large storage piles at Panama. These are mostly Pocahontas, which produces an abnormal amount of dust.

The Bureau of Mines makes the following recommendations:

1. Do not pile bituminous coal so that any point in the interior will be more than ten feet from an air-cooled surface.

2. If possible, store only lump.

3. Keep dust out as much as possible, therefore, reduce handling to a minimum.

4. Pile so that lump and fine are distributed as evenly as possible; not, as is often done, allowing lumps to roll down from a peak and form air passages at the bottom.

5. Rehandle and screen after two months. Even if considerable heating has taken place this handling will cool it off and combustion seldom takes place afterward.

6. Keep away external sources of heat even though moderate in degree.

7. Allow six weeks seasoning after mining before storing. This allows the surface of the lumps to become less liable to oxidation.

8. Avoid alternate wetting and drying. Eastern coals may be stored under water in safety without loss. Western coals take up too much water under such treatment and much heat is lost in steaming out this absorbed water.

9. Avoid admission of air to interior of pile through interstices around foreign objects such as timbers or irregular brick work; also through porous bottoms such as cinders.

10. Do not try to ventilate by pipes as more harm is often done than good.

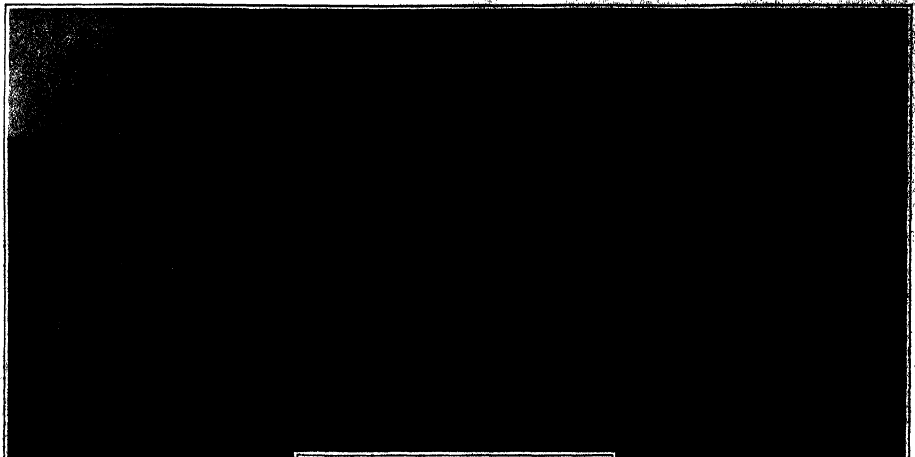
Charcoal, because of its great porosity, is peculiarly liable to spontaneous combustion. Its use as a deodoriser depends on its wonderful power of absorbing gases and experiments have shown that after exposing to a white heat for three hours charcoal can still retain a small amount of absorbed gas. Its enormous inner surface for contact with oxygen is often its own destruction. Charcoals made from some woods ignite as soon as exposed to the air. In 1911 there were sixty-four reported fires in the transportation of charcoal in this country alone, and of these all but one were apparently due to spontaneous combustion.

A farmer's barn stored with green hay is always in some danger. Unless the juices were properly sun-dried considerable fermentation takes place in the mow and the heat generated facilitates oxidation. The mass of hay is often so great that in the interior heat is developed faster than it is conducted away and then the ignition point is approached and possibly reached.

What About the Wheels?—It is interesting to note that in nine cases out of the proverbial ten, the wheels—most vulnerable parts of all—of armored automobiles are left practically unprotected. One well-directed shot might very easily so cripple the average armored car as to place it completely at the mercy of anyone with real or fancied reason to accomplish its downfall. The necessity for properly armoring wheels as well as bodies is very real and very earnest and cannot well be overlooked.

Safety in an Automobile Factory

Methods That Have Produced a Sixty Per Cent Reduction in Accidents

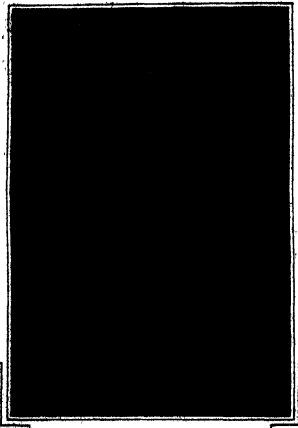


Forced draft apparatus for drawing steel particles from the grinding room.

"SHOW me the conditions for an accident," says a prominent safety official, "and I will show you the accident." He is associated with the United States Steel Corporation, which employs so many men that almost every kind of an accident that might occur has occurred at one time or another in its history. When a possible source of danger is pointed out to the foreman of a shop, he is quite apt to laugh at the idea of any risk. "Why," he will exclaim, "we have worked here twenty years without an accident." To this the safety inspector can almost invariably reply that such an accident did once happen in such and such of their own plants, and there is no reason why it should not occur here at almost any time. The need of safety precaution is more apparent in a large corporation employing hundreds of thousands than in factories employing but a few hundred. Yet it is no less real in the latter than in any one of the plants of similar size in the big corporations. If safety precautions pay in one, they should pay in the other.

This high-speed machine may be stopped instantly by the emergency brake shown at the right.

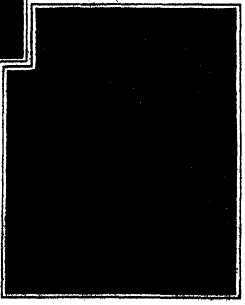
We love to dwell on the more noble, humanitarian side of the safety movement. But it is not merely a question of philanthropy; it pays in dollars and cents. Employers must not forget that it costs something to break a new man into the work. Every workingman is an asset to the company, and if he be incapacitated by accident, the employer must figure among other losses that of the money invested in this man's training; for in order to replace him, he must go through all the trouble and expense of breaking in a new man. This is so in almost any line of work, but particularly in those factories where the work is of a highly specialized character.



The hammer cannot drop until the workman has removed his hands from under the safety cross bar.

By way of illustration, we have reproduced on this page some of the safety precautions used in the factory of the Packard Motor Car Company, at Detroit, Michigan. The factory is by no means a small one. In fact, it is one of the largest automobile factories, employing about ten thousand men. But in point of size, it is not to be compared with the United States Steel Corporation, for instance, which employs about two hundred thousand men. Nevertheless, the Packard Company has found that it pays to develop an elaborate safety system. At the head of its Bureau of Safety is an expert machinist, whose whole time is employed in installing protective devices, and educating workmen in precautionary measures. Every day he and his assistants make the rounds of the shop, hunting for uncovered flywheels, exposed gears, unprotected belts, projecting set-screws, and all other possible sources of danger to workmen.

Primarily, the shops were designed with a view to giving each machine more than the usual amount of working space, and plenty of daylight. One of the principal sources of danger in the ordinary machine shop arises from the crowded condition of the rooms, and the cluttered condition of the floors. Give a man plenty of room and plenty of light, and not only will he be less liable to injury from contact with moving parts of the machine, but his improved surroundings will react upon the work that he puts out. So far over five hundred different devices have been installed in the plant to do away with risk. These devices consist not only in the customary guards, but in other precautions, a few of which are shown in our illustrations. An elaborate forced draught system has been installed for drawing off particles of steel from the grinding room, so that this room is free from injurious dust. In the body plant, the aluminium bodies are prepared for paint by a blast of fine steel shot. So powerful is this blast that it would tear the toughest oak frame to shreds. Hence the workmen must be protected, and they are furnished with heavy helmets which drop over their shoulders. One of the photographs shows a heavy hammer in the forge shop, fitted with a safety device to prevent a man from having his hand mangled. A safety cross bar projects across the table of the machine. To introduce the work the operator has to lift this cross bar. Then the hammer will not drop until the workman has removed his hand, allowing the safety bar to strike the machine base. Another special safety device is an emergency brake for a high-speed lathe. In case of accident, the machine can be checked instantly by the use of this brake.



In the body plant the workmen are protected by heavy helmets from the blast of steel shot.

The Bureau of Safety at the Packard plant has been working only two years, but in that time the number of accidents in the factory have been decreased 60 per cent. Do safety precautions pay?

The Strangest Form of Cloud: Mammato-cumulus

THE accompanying photograph, which is from the collection of the United States Weather Bureau in Washington, is probably the most remarkable picture ever made of the rare variety of cloud known to meteorologists as *mammato-cumulus*. It was taken by Mr. L. C. Twyford, at Bartlesville, Oklahoma, who reports that about 45 minutes before these clouds were seen a destructive tornado occurred some 20 miles away in the direction from which the clouds came. Clouds of this type seem to be especially associated with a severe storm. They were seen by Prof. H. C. Frankenfield at St. Louis in connection with the tornado and just before it did so much damage in that city on May 27th, 1896.

The earliest description of mammato-cumulus appears to have been that contributed by the Rev. Charles Clouston to Dr. Mitchell's "Popular Weather Prognostics of Scotland" (1863), and subsequently in a work by himself on the same subject. In the Orkneys, where he resided, it was well known to seafaring men under the name of "pocky cloud" ("pock" or "poke" being a dialect term for a bag), and was regarded as a sure sign of a coming storm. Clouston compares it to "a series of dark cumulus-looking clouds, like *festoons of dark drapery*, over a considerable portion of the sky, with the lower edge well defined, as if each festoon or pock was filled with something heavy; and generally one series of festoons lies over another, so that the light spaces between resemble an Alpine chain of white-peaked mountains."

The characteristic form of this cloud is expressed by others of its numerous names, as "festoon-cloud," "mammiform cloud," "udder-cloud," and "sack-cloud." In Lancashire the festoons are known as "rain-balls," and are regarded as a sign of rain.

The peculiar feature of mammato-cumulus is that the rounded protuberances appear to project downward from the general cloud layer. Some writers have suggested that they are not really projections from the latter, but separate rounded clouds, having a more uniform sheet of cloud above them. Various other explanations have been offered.

From Monthly Weather Review. Photographed by L. C. Twyford, Bartlesville, Okla.

Mammato-cumulus clouds.

This picture was taken looking up at an angle of 85 degrees; i. e., nearly perpendicular.

A Portable Field Searchlight

By the Berlin Correspondent of the Scientific American

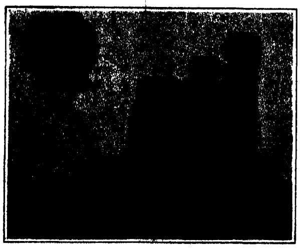
THE experience of recent wars has strikingly shown the benefit to be derived from skillfully operated electric searchlights. With the probability of night operations increasing in the wars of the future, the equipment of field armies with searchlights suitable for military uses has become a necessity. Now all the excellent systems adopted in actual practice, are designed to be conveyed on cars and therefore are difficult to handle on mountainous ground.

The Messrs. Siemens-Schuckert Works, which has taken such a prominent part in developing the electric searchlight, has succeeded in producing a portable field searchlight outfit, likely to comply even with the most exacting requirements. While using a very efficient parabolic glass mirror 35 centimeters (13.8 inches) in diameter of a range of 1,000-1,500 meters (3,281-4,921 feet) this outfit, inclusive of the gasoline, water and oil required for an 8 to 10 hour operation, weighs only about 300 kilogrammes (661 pounds).

The various parts of the set are designed to be transported most easily. They make four packages, each of about 80 kilogrammes (176.4 pounds), and are fitted up or taken apart in about five minutes. The operative parts, motor, dynamo and accessories, are fitted on a frame, readily moved to and fro by means of handles. The small searchlight, which is handled independently of the motive part, comprises two conductors each 100 meters (328.1 feet) in length (wound on cable drums), and all adjusting arrangements, inclusive of the tripod frame, weigh only 47 kilogrammes (103.6 pounds).

It will readily be understood that an outfit of so moderate weight, designed to be loaded on four animals walking independently of one another, should be able easily to follow an army even on almost impracticable ground, e. g., in the highlands on the steepest and most narrow mountain paths. The searchlight will be used advantageously both in signaling backward and in keeping up a connection with detached posts. It will also be found most useful in watching the course of a river, or a chain of lakes, if the vegetation on the banks is too dense to allow any searchlight cars to approach. Another case where the new outfit is likely to render valuable services is that of the equipment of expeditionary forces and detached troops, likely to encounter extremely difficult ground. On incursions in colonies and other territory, the addition of portable searchlights will prove of inestimable service, in exploring and defending the ground, the more so as the outfit can at the same time be used for signaling.

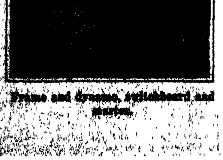
The portable outfit comprises a gasoline motor with radiator and fuel tank, a leather clutch and a dynamo, mounted on a common frame, a searchlight and tripod as above described, two cable drums, a water bag and the tool casing, the whole being readily carried by four mules in packages each of about 80 kilogrammes.



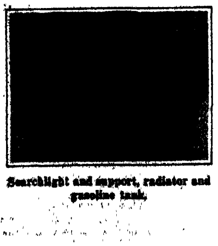
Complete outfit of the portable field searchlight.

The gasoline motor develops 4 to 6 horse-power at a speed of 1,500 revolutions per minute. It is equipped with a fly-wheel, magneto, governor and valve gear, cooled by an extra large thermosyphon radiator and fitted with a fan driven from the motor shaft. The oil tank and hand pump are fixed to the motor by means of a bracket. A leather clutch connects the motor with the shunt-wound dynamo, which at a speed of 1,500 revolutions per minute develops a tension of 65 volts and an intensity of 22 amperes. The inductor housing has been made of cast steel and the bearing brackets of aluminium, in order to keep down the weight. The most indispensable instruments and switches, an instantaneous switchout, a fuse, a voltmeter and two terminals for connecting up the two cables each 100 meters in length, have been provided. The motor, frame and radiator are fitted with handles allowing the whole set to be readily lifted.

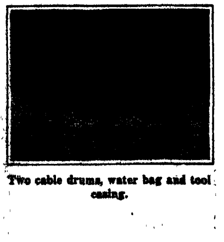
The four packages carried by the mules comprise the following parts: First mule: Searchlight and supports, radiator and water and cooled gasoline tank. Weight, 82 kilogrammes (180.8 pounds). Second mule: Frame, dynamo, and leather clutch, switchboard and instruments, inclusive of the starter Weight, 80 kilogrammes (176.4 pounds). Third mule: Gasoline motor and oil tank. Weight, 83 kilogrammes (183 pounds). Fourth mule: Two cable drums and 2 by 100 millimeters (0.08 by 3.94 inches) cable, filled water bag and tool casing. Weight 55 kilogrammes (121.1 pounds). The weight of the harness (saddle and accessories) varies between 27 and 30 kilogrammes (59.5 and 66.1 pounds).



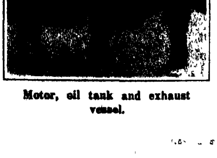
Frame and dynamo, switchboard and starter.



Searchlight and support, radiator and gasoline tank.



Two cable drums, water bag and tool casing.



Motor, oil tank and exhaust vessel.

The Expanding Weather Map

ON January 1st the Weather Bureau began publishing at its central office in Washington a daily telegraphic weather map of the northern hemisphere. It appears on the reverse side of the ordinary weather map of the United States (i. e., the lithographic map issued in Washington, which is larger and more complete than the maps issued in other cities throughout the country), and is drawn on a circum-polar projection. Although the observations plotted on this map are not strictly synchronous (e. g., observations taken in Japan at 4 oclock yesterday afternoon, Washington time, are brought into comparison with those taken in the eastern United States at 8 o'clock this morning), they coincide nearly enough in time to make plain the broad features of pressure and temperature distribution, and especially the vicissitudes of the great "centers of action" to which weather forecasters attach so much importance.

Aside from the compact network of reporting stations in the United States and Canada, the data on which the chart is based are rather sparse, the total number of other stations, including those in Alaska, being only forty-one; so that much of the map is obviously conjectural. This is a defect which will undoubtedly be remedied in time; probably through an agreement on the part of all civilized countries to exchange their weather reports by telegraph. The plan of a *réseau mondial* of this sort was a favorite idea of the late Teisserenc de Bort, and an international commission was formed some years ago to take steps toward its realization. The great blanks over the oceans, at present inevitable, will doubtless be partly filled up by wireless reports from marine observers, just as soon as the serious delays now involved in relaying messages from ship to ship have been eliminated or reduced to a minimum through improvements.

The United States Weather Bureau is to be congratulated not only upon being the first institution in the world to publish daily telegraphic weather maps of a hemisphere, but also upon setting the example of using on such maps dynamic units of barometric pressure (millibars) and degrees of temperature on the absolute scale. The isobars on the new maps are drawn for intervals of five millibars, and the isotherms for intervals of ten (in some places five) degrees absolute. Their appearance is neither strange nor confusing to persons habituated to the old units. The British Meteorological Office is planning to use these units on its regular daily weather map after May 1st of this year, and it seems certain that other countries will follow suit.

The advantages of the new units have already been set forth from time to time in the SCIENTIFIC AMERICAN.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Pertaining to Apparel.

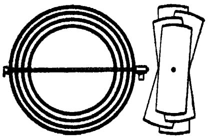
COLLAR SUPPORT.—L. M. GRAUBARTH, care of Josef Friedman, Inc., 114 Fifth Ave., New York, N. Y. The invention relates to negligee shirts having soft turned-down collars, and provides a support or stiffener arranged for convenient attachment to the collar to prevent the turned-down front portions of the collar from wrinkling up, and to hold the same in properly stretched positions, thus insuring at all times a neat appearance of the collar.

Electrical Devices.

ELECTRO-HYDRAULIC CONTROLLER.—C. ENGBERG, care of Engberg's Electric and Mechanical Works, St. Joseph, Mich. This invention comprises a system of valves particularly related with respect to means for controlling the valves, whereby the fluid may pass in different directions at will through the different chambers, a common outlet being provided.

ELECTRIC HAMMER.—J. O. FIELDS and R. L. FIELDS, 280 Downard St., Zanesville, Ohio. The principal object of the invention is to provide an improved contacting device especially adapted for use on electric hammers and adapted to be actuated by the beam of the said hammer whereby the distance through which the hammer head travels may be varied.

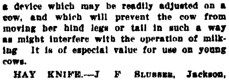
LOOSE COUPLED TUNING COIL.—A. C. GOWING and M. C. SPENCER, care of the former, 1 Lancaster Terrace, Worcester, Mass. This coil is for use in wireless telegraphy and other arts in the propagation of electric waves through space. It consists of primary and secondary windings, the former composing two sections which can be independently adjusted with regard to each other, and the latter likewise comprising two sections capable of independent adjustment, so that self-inductance of both windings can be regulated at will, and, at the same time, the mutual inductive effect of one winding upon the other can also be controlled with the utmost nicety


LOOSE COUPLED TUNING COIL.

Of Interest to Farmers.

RESTRAINING DEVICE.—J. R. INABNIT, Witsall, Mont. The object here is to provide a device which may be readily adjusted on a cow, and which will prevent the cow from moving her hind legs or tail in such a way as might interfere with the operation of milking. It is of especial value for use on young cows.

HAY KNIFE.—J. F. SLUSSER, Jackson, Idaho. This invention relates more particularly to a hay knife embodying a cutter which is movable with respect to the handle thereof, the purpose being to do away with the body strain incident to the usual form of hay cutting knife in cutting hay in the stack. The knife is easily operated without assuming cramped positions or working upon the knees.


HAY KNIFE.

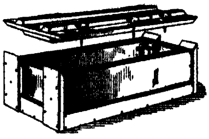
MEANS FOR IMPROVING LAND.—R. H. SPARKS, Terre Haute, Indiana. An object of the improvement is to provide a device by means of which sloping land that is being eroded from storm water, may be made to receive deposits of silt at certain places, and to maintain cultivation when said deposits are being made.

Of General Interest.

COLUMN.—J. F. MAY, 110 Conselyea St., Brooklyn, N. Y. This invention relates to columns of the type comprising a shell or casing of metal or other fireproof material designed to be filled with concrete, and the aim thereof is to produce an improved cap and base for the shell or casing forming the body of the column, so constructed that both the cap and the base will automatically center and lock themselves to the body of the column as soon as they are put in place.

MEANS FOR THE MAINTENANCE OF GAS IN CONFINEMENT.—S. E. BRETHERTON, 220 Mills Bldg., San Francisco, Cal. The invention relates to metallurgical and similar processes, and provides means for the maintenance of gas in confinement while agitating, decanting and refilling vessels with solutions either continuously or intermittently and without danger of free air from outside sources passing into the apparatus, thus preventing dilution of the gas and impairment of the decanting process.

ROUGH BOX.—W. M. GLOVERLEY, Ohiopyle, Pa. This invention relates to receptacles used for holding caskets and coffins, and used more particularly for shipping the latter, whether the coffins be empty or contain human remains, at burial. The lid is self adjusting in the sense that when fitted approximately into position it will move into exact registry, thus making a perfect fit. The screw holes are thus brought into precise registry, so as to facilitate the application of the screws. Moreover, the various bevel surfaces of the body portion promote ease of handling the casket in that the casket as lifted into and out of the body portion of the receptacle, is guided to some extent by the bevels.


ROUGH BOX.

STERILIZING AND PRESERVING APPARATUS.—N. J. DARDEN, Memphis, Tenn. This invention provides a device by means of which articles which are to be preserved may have the surrounding air removed and replaced by a fluid sterilizing medium, such as ozonated air, carbonic acid gas, etc., and in which the articles so treated may be sealed hermetically, so as to prevent the spoiling or decaying of the articles so treated. Mr. Darden has invented another sterilizing and preserving apparatus by means of which the sterilizing medium may be passed through the receptacle which contains the food-stuffs, first one way and then the other, thereby insuring the thorough permeation of the sterilizing medium.

FLUX FOR ALUMINIUM SOLDER.—H. HAMMAR, Delhi, N. Y. In the present invention the improvement has for its object the provision of a flux of aluminium solder consisting of soft soap and beeswax which may be easily manufactured and may be used with a blow pipe with the aluminium solder.

HEAD GATE.—J. T. FITCH, Helper, Utah. The object of this invention is to provide a simple, strong, inexpensive and balanced gate which can be quickly and easily operated and which is provided with means indicating the size of opening made by the gate.

METALLIC BUILDING.—W. W. TAYLOR, care of J. H. Taylor & Bro., 219 Glenridge Ave., Montclair, N. J. This invention relates to metallic buildings adapted to be shipped in knocked-down form, and more particularly to a building especially adapted for use as a garage. The various elements may be assembled with the parts properly adjusted and secured without the exercise of great skill, and without great care on the part of the workmen.

PROCESS FOR PRECIPITATION OF ZINC.—F. L. WILSON and S. E. BRETHERTON, care of latter, 220 Mills Bldg., San Francisco, Cal. The purpose in this invention is to obtain a constant precipitation of metallic zinc from an electrolytic bath and obviate the necessity of installing reduction furnaces for the production of the same.

STOPPER CAP.—R. H. MOLONEY, 315 73rd St., Brooklyn, N. Y. Among the principal objects which the present invention has in view are: to provide for bottle stoppers a detachable cap; and to provide a cap for the purpose set forth having a screw thread adapted to cut or sink into a cork of conventional construction.

BOOK MARKER.—W. A. OVERBECK, 822 E. Cleveland Ave., Salt Lake City, Utah. This invention relates more particularly to a member adapted to clamp a page. An object is to provide an inexpensive and simple book marker that will have a firm grip on the paper and will not injure or mar the page in places of contact with it.

GLASS CLEANER.—L. G. HATOSY, JR., 604 E. 135th St., New York, N. Y. This cleaner permits the barkeeper or other person to conveniently, quickly and thoroughly clean the glasses, and to allow of setting the cleaner into the washing or rinsing tank of a bar or of removing it therefrom whenever it is desired to do so for replacing worn out brushes by new ones or for other purposes.

HAME CLIP.—W. A. PICKARD, care of Mead & Whitcomb, 411 Sunset Bldg., Bellingham, Wash. This invention provides a clip so attached to the hame that weakening of the latter is avoided, and so connects the movable part of the clip to the stationary part carried by the hame that freedom of movement will be provided so that the trace will pull at right angles to its securing bolt, whereby strain against the animal's shoulders will be evenly distributed and splitting of material forming the trace, usually due to angular pull thereon, will be avoided.

Hardware and Tools.

COMMUTATOR SLOTTER.—J. E. [illegible], 708 Ninth Ave., Seattle, Wash. The improvement refers to a hand tool for slotting commutators, and it has for its general object the provision of a tool whereby the slots between the commutator bars of a dynamo-electric machine can be quickly and accurately made and with uniformly good results.

CIGAR TUCK CUTTER.—G. W. BOWMAN, 409 S. George St., York, Pa. This invention relates to cutters or trimmers for use by makers of cigars for trimming the ends or tucks thereof. It improves and simplifies the construction of the cigar cutters so as to be reliable and efficient in use, comparatively inexpensive to manufacture, and so designed as to insure a uniform size of cigar.

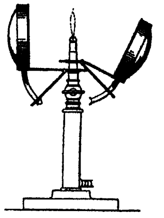
STRIPING TOOL.—J. E. [illegible], Harrington, Wash. This improvement has reference to striping tools for use by painters in wagon work and the like; and particularly to that class of tools in which the handle forms a container for the paint, and has means for detachably holding a striping brush.

WRENCH.—J. [illegible], [illegible] Emerson St., Lincoln, Neb. This invention relates to improvements in wrenches, and has for an object to provide an improved self-adjusting wrench which will automatically grip pipes, bolts, nuts and the like, without manipulation of any adjusting members.

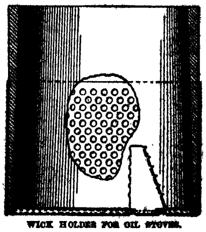
LOCKING DEVICE FOR HAND DRILLS.—G. L. WILCOX, 167 W. 71st St., Manhattan, N. Y., N. Y. The purpose in this instance is to provide a new locking device for hand drills more especially designed to enable the user of the drill to readily and quickly manipulate the drill chuck for the insertion, fastening or removal of the boring or drilling tool.

Heating and Lighting.

LIGHT INTENSIFIER.—G. [illegible], 23 John St., New York, N. Y. This invention relates to illumination or lighting apparatus, and has particular reference to easily and adjustably controlled means for increasing the light from a gas jet or any other suitable source of light for any purpose such, for instance, as for the use of workmen or artisans on a bench or the like. The lens meets the requirements of any particular user without interfering with or disturbing any other similar lens holders which may be located on the same jet.


LIGHT INTENSIFIER.

WICK HOLDER FOR OIL STOVES.—JOHN F. BITTLE, Lisbon, Iowa. The common form of a wick holder consists of a perforated cylindrical shell, the lower end of which is inturned and forms a binding over the wick, at the inside of the holder. As the wick in the old holder mentioned is permanently secured in place, it cannot be renewed, so that a new holder is required to renew the wick. In the present invention a novel clamping means is provided in connection with the holder, to detachably engage the wick, so that the remnant of a burned wick may be readily removed and a new wick secured to the holder.


WICK HOLDER FOR OIL STOVES.

HEATING SYSTEM.—P. [illegible], 54 Rue Lepic, Paris, France. This invention has for its object an arrangement for generating pressure and maintaining the same in steam generators without the use of fuel and the invention may be applied for instance to the so-called mixed electric plants, comprising electric machines combined with hydraulic and steam engines.

Household Utilities.

BATH SHOWER.—C. & C. [illegible], 304 W. 146th St., New York, N. Y. This bath shower occupies a small amount of space [illegible] the least amount of [illegible] into or [illegible] apparatus dispenses with [illegible] or apron to prevent [illegible] over the bathroom floor.

SADIRON STAND.—M. [illegible] K. Bartlett, [illegible] First National Bank Bldg., Oakland, Cal. This invention is a [illegible] stand or support for heated [illegible] called flatirons, and it is formed of a [illegible] produced by winding a strip of [illegible], and a metal band encircling the same and provided with a lateral handle, constructed integrally with the band. A series of rods extend through the body parallel to its surface and serve to reinforce the same so that it remains flat under all conditions of use.

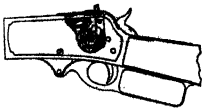
FASTENER FOR IRONING COVERS.—[illegible] M. BROOKMAN, 762 Spaulding St., [illegible], N. Y. This fastener is arranged to permit of conveniently and properly stretching the cover over the board and securely fastening the same in place on the board, and to permit of removing the cover from the board for removal and renewal of the facing sheets of the body of the cover.

WINDOW SHADE FIXTURE.—A. [illegible], 175 Clinton St., Brooklyn, N. Y., and L. [illegible], N. Y., N. Y. This invention provides retainers for the edges of window shades to normally hold the shade in desired positions; and provides means whereby if the shade is forced out of normal position, the same may be returned without further damage to the fabric thereof.

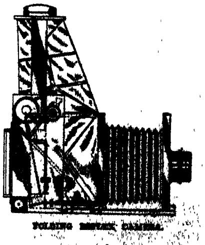
Machines and Mechanical Devices.

COMPOUND LEVER.—W. V. [illegible], London, England. Address Day, Davies & Hunt, 321 High Holborn, London, England. This invention has for its objects to construct a compound lever which will be compact and will enable the equivalent of an almost completely extended long limbed toggle to be utilized in the transmission of movement, so that an efficient and sustained leverage is available, and which may be adjusted to enable different operations to be obtained from a given actuation.

SIGHT FOR FIREARMS.—M. P. NASH, U. S. Navy, care of George C. Lawrence, 317 Washington Ave., Brooklyn, N. Y. This invention provides a sight for rifles and other firearms, and is arranged to permit the user of the firearm to conveniently and accurately raise or lower the eye-piece of the sight for different ranges to visually indicate the range to which the eye-piece is set, and to audibly indicate a change in setting the eye-piece. The engraving shows a side elevation with the sight fitted to a rifle. The inventor and his partner, Lieut. Commander J. M. Enochs, U. S. N., recently tested out the sight on the Government range at the Navy Yard, Mare Island, with very good results, it being fitted at the time with one of the new Springfield rifles.


SIGHT FOR FIREARMS.

CAMERA.—ANTHONY VORIS, 15 Cottage St., Jersey City, N. J. This invention relates to photographic apparatus, particularly to devices known as folding reflex cameras. It permits the operator to view a full size non-inverted image up to the moment of exposure. The apparatus of which a side view of a slightly modified form is shown in the engraving, may be folded into a very compact casing or housing when not in use. Means provide for automatically and quickly erecting the focusing hood and mirror upon dropping the [illegible] and vice versa. Provision is made for the use of a pleated bellows when long [illegible] are used, and their removal for [illegible]. This apparatus has in addition many other novel features of construction and operation.


FOLDING REFLEX CAMERA.

COMBINATION LOCK.—[illegible], Jenkins, Ky. This invention [illegible] wherein [illegible] between [illegible]

[illegible]

[illegible] MACHINE.—C. C. [illegible], care of [illegible] Co., 38 Wall St., N. Y., N. Y. [illegible] is an improved [illegible] and its object is to devise a [illegible] by means of which a number of sheets of paper or cardboard can be divided into a number of small pieces of regular shape, with little or no waste of the material employed.

HEAD GATE.—J. E. [illegible], care of Milwaukee House, Deer Lodge, Mont., and W. D. [illegible], Aberdeen, Idaho. The improvement is capable of embodiment either in a permanent head gate, or in a portable head gate adapted to be located at any point in a ditch, to raise water therein where desired. Valve means are provided for commanding the opening in the gate, and a novel arrangement of manually-controlled operating rod and guide therefor.

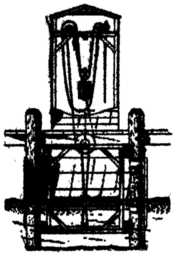
SAFETY DEVICE WITH COMBINATIONS FOR LOCKS OF ALL KINDS.—L. J. M. Dassand, 39 Rue de Lyon, Paris, France. The results accomplished by this device are due not only to the movableness of the safety elements or members located in the lock, but also to a key having removable members or counterparts in order that the change of the safety elements or members effected in the lock can also be effected instantaneously on the key, to allow of obtaining the necessary cooperation between these two parts of the lock.

WASHING OUT AND REFINING MACHINE.—H. Paats, 2 Vogelgesang, Burg, near Magdeburg, Germany. This invention relates to starch making machinery, and its object is to provide a washing out and refining machine arranged to effectively separate the starch from the pulp, and to allow of carrying on the washing out and refining operations in a single machine.

MITERING MACHINE.—F. Maximilian, 521 W. 37th St., New York, N. Y. This machine is more particularly adapted for glass-working. The principal object is to provide a machine especially adapted to miter glass through the aid of suitable tools, the construction and arrangement being such that the feeding means for the said tools is avoided.

Prime Movers and Their Accessories.

TIDE MOTOR.—W. Braunsdorf, 3440 Broadway, N. Y., N. Y. This invention relates to tide motors and particularly to power devices of this character adapted to operate substantially automatically in accordance with rise and fall of the tide. A float and means are provided to control the vertical reciprocations thereof with the tide and to cause the float to automatically grip an endless chain to cause the same to be operated from the float while the latter is rising or falling. The power storage device when detached from the tide motor can be applied to store power on windmills, and can be used as a hand weight motor for home use. The inventor claims that the power produced by his tide motor will cost one third of the price of electric power.



TIDE MOTOR.

VALVE FOR INTERNAL COMBUSTION ENGINES.—O. Ernst, Larchmont, N. Y. The valve is preferably of the rotary type, and the inventor's object is to provide a construction of this sort in which all defects inherent in rotary valves for gasoline motors are eliminated. To this end he constructs a valve with members that are so mounted as to have a certain degree of [illegible] play in the bearings [illegible] of the same.

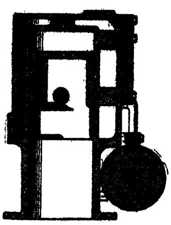
VALVE FOR INTERNAL COMBUSTION ENGINES.

[illegible]

object here is to provide a form of packing which will be associated with a valve in such a way as to make the same fit snugly at all times to its seat and totally eliminate leakage of steam or other fluid between said valve and the sides of the casing in which the same is contained.

GASOLINE FILTER.—C. A. Post. Address Fred Catchpole, Pagosa Springs, Colo. This simple device is adapted to be interposed between the source of supply and the carbureter for thoroughly and automatically purifying the liquid fuel, and wherein means is provided for shutting off the supply of fuel when the filter needs cleaning.

GAS ENGINE VALVE.—F. C. Gonzales, care of Ripley Congregational Church, Traer, Iowa. This invention is an improvement in gas engine valves, and has for its object, the provision of a direct acting valve for use with engines of the character specified, which will be comparatively noiseless in operation, simple in construction and in operation, accessible for the cleaning or the like, and having a large bearing surface, so that wear is reduced to a minimum.



GAS ENGINE VALVE.

PISTON RING.—H. H. Patrick, 50 Sandwell road, Handsworth, Birmingham, England. This invention relates to piston rings, for, more especially, internal combustion engines, although it is not limited to such rings, being applicable to cast iron and steel piston rings for a variety of purposes. In this invention the method of making split piston rings consists in the employment of a pair of similar and coaxial metal rings and uniting a pair of opposite overlapping ends along a portion of their adjacent side faces by welding.

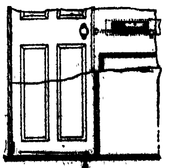
EXPLOSION MOTOR.—James MacConaghy, deceased, Boulogne-Sur-Mer, France, care of Charles Philips, 1122 Mission St., San Francisco, Cal. In the present patent the invention has for its object an explosion motor of the multiple cylinder type, capable of developing a great horse-power under a small volume and applicable by this fact, either to motor vehicles, or to apparatus for aerial locomotion.

Railways and Their Accessories.

CAR COUPLING.—C. A. McKeeahan, 420 Air Brake Ave., Wilmerding, Pa. This coupler is provided with a block for locking a tail piece of the knuckle, there being a lever, one arm of which is adapted to be engaged by the block, the block on the other arm of the lever engaging the cam surfaces of the tail piece to operate the knuckle as the block is raised or lowered. Means provide for raising or lowering the block from the side of the car.

SMOKE CONSUMER.—J. O. Richard, 515 Michigan Ave., Hammond, Indiana. The principal object here is to provide a smoke consumer especially adapted for use on locomotives, whereby the boiler pressure is utilized to provide a draft in order to carry back the products of combustion into the fire box after such products have been mixed with a desirable quantity of air.

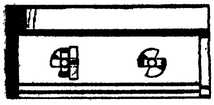
FARE REGISTER.—L. J. Harris, Albany, Ga. This invention comprehends mechanism controlled partly by the weight of the passenger entering the car, and partly by a voluntary or manual act of the passenger independently of his weight, for preparing a record of the number of passengers taken aboard at various stations, and also for indicating respectively the various destinations for which the several passengers are bound.



FARE REGISTER.

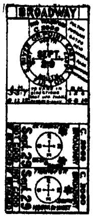
MEANS FOR SUPPORTING AND RELEASING RETAINING STAKES.—J. D. Mauch and F. Martin, Rib Lake, Wis. This invention provides a casing having means whereby it can be secured to the bolster of a car, which is provided with a bolt having locking means. A shoe which carries the stake has means adapted to engage the casing and to be secured by the bolt to the casing, with the locking means preventing the accidental displacement of the shoe from the casing.

BOLT.—J. S. Wait, Jr., and A. Halliday, care of the former, 324 Third Ave., Two Harbors, Minn. This invention is an improvement in bolts, and has for its object the provision of a bolt for use with fish plates for connecting rail ends so constructed that the fish plates may be clamped together on the rail ends, and held firmly in such position, without the necessity of threaded holding nuts and bolts.



BOLT FOR USE WITH FISH PLATES.

TRANSFER TICKET.—W. Klein, Jr., 11 Devoe St., Brooklyn, N. Y. This ticket is particularly designed and adapted for use in transferring passengers from one line of cars to intersecting lines, and for this purpose the ticket is composed of a body or main portion, transfer and retransfer portions having various peculiarities. The accompanying engraving represents the transfer, which is a composite ticket.



TRANSFER TICKET.

RAIL JOINT.—J. W. Enright, 862 Tchoupitoulas St., New Orleans, La. This invention relates to railway construction and has particular reference to means for connecting the adjacent ends of the railway rails. Among the objects is the provision of a rail joint which may be rolled and which, when in assembled position, serves to clamp the rails in a peculiar vise-like manner.

MEANS FOR THE INTERCHANGE OF MESSAGES BETWEEN A STATION AND A MOVING CAR.—O. H. Smith and J. L. Smith, Stratford, Pennsylvania. Address the former. This invention relates to mechanism of the character set forth in a previous patent, No. 1,042,983, issued to these inventors. It provides a system of tubing leading from a railway station or other building in the proximity to a railway track, such tubing being adapted to deliver carriers to and from a car, such carriers being received and deposited by the car as it moves along.

Pertaining to Recreation.

HAND BALL GLOVE.—J. I. Brokaw, 160 W. 66th St., Manhattan, N. Y., N. Y. The purpose in this case is to provide a glove with which it is possible for a player to return the ball accurately, and with great speed. In the game of hand ball, gloves are worn not as a protection for the hand, but to increase the efficiency of the player.

Vehicles and Their Accessories.

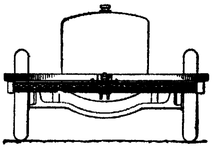
TIRE DEFLATING CAP.—J. H. Hard, Allen, Neb. A cut of the device appeared in this journal November 22nd, 1913. It consists of two caps joined at their bases; either cap screwing upon a valve stem; one serving as a valve cap, the other having a central pin depressing the valve, releasing air through holes in the wall of the cap. Also a core remover with a base which screws into either cap, where it may be carried when not in use.

SPRING WHEEL.—C. N. Snowden, Soledad, Guantanamo, Cuba. This invention pertains to spring wheels more particularly designed for use on automobiles, and more especially to that class in which there is an inner hub and spoke section having a rim, and an outer tire rim. The invention provides a novel spring means affording a cushioned connection between the inner rim and the tire rim.

VARIABLE SPEED MECHANISM.—D. E. Crouse and C. G. Eidson, Annapolis, Md. This invention provides a mechanism for use in automobiles and similar vehicles which will dispense with the noise ordinarily occasioned when gears are brought into mesh. The invention provides a variable speed mechanism in which the changing of the speed is accomplished by the mere shifting of a switch in an electric circuit.

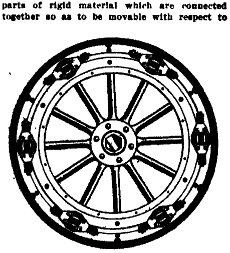
AUTOMOBILE LAMP.—W. F. Dorsman, Box 96, Cumberland, Md. The present invention relates to automobile lamps, and particularly to that character of lamps and their attachments by which the lamps are caused to turn on vertical pivots for the purpose of following the direction of turning movement of the machine, connections between the lamps and steering gear being had for this purpose.

VEHICLE FENDER.—D. Ghezzi, care of C. Zerbani, 846 Broadway, N. Y., N. Y. Among the principal objects which the present invention has in view are: to provide an apparatus of the character named having a yielding buffer and grasping arms arranged to support a body from falling; and to provide means whereon the body may rest, or recline after being lifted from the ground. A buffer may be placed sufficiently low to catch and carry a child while arms may be disposed so that if the buffer be struck, they will grasp a person at the height of the hips, waist or shoulder.



VEHICLE FENDER.

RESILIENT TIRE.—R. Curry, 1436 Prospect Ave., Bronx, N. Y., N. Y. The intention here is to do away with the necessity of using rubber tires, by providing a tire made up of parts of rigid material which are connected together so as to be movable with respect to one another, and so constructed that the same can be applied to almost any wheel now in use. The extent to which the principal parts are movable is regulated by cushioning devices or suitable resilient means which are introduced between the same, and the whole is suitably incased to guard against the intrusion of mud or dirt when the same is in service.



RESILIENT TIRE.

NON-SKID TIRE SHOE.—H. Strongson, 68 E. 97th St., Manhattan, N. Y., N. Y. This invention provides an article having spaced-apart members moving relative to the tire to form independent gripping sections to permit movement of the tire thereon, provides resilient means for returning the gripping sections to normal position, provides for adjusting the shoe to wheels and tires of different dimensions; constructs an article to permit the removal for repair or replacement of sections thereof; and provides an article which may be folded or packed within small compass.

Designs.

DESIGN FOR A DOLL HEAD.—J. G. Kaempfer, care of Maurice L. Shaine, 850 Broadway, N. Y., N. Y. In this ornamental design for a doll head, the head is round, the face chubby, the eyes very large and the mouth open. The hair is smooth except a slight wave and a lock curling down the forehead.

Note.—Copies of any of these patents will be furnished by the Scientific American for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

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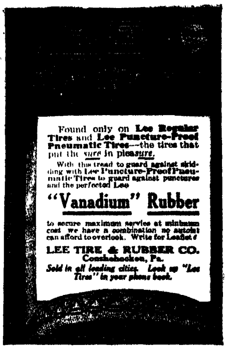

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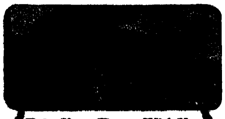

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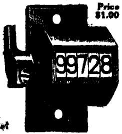

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Safety in Steel Works

(Concluded from page 122.)

which was provided, at heavy expense, in a pipe mill of the National Tube Company at McKeesport, Pa. When the building was erected no provision was made for the cleaning of the windows in the saw-tooth roof. The window cleaner had to cling to the molding and the steel work of the roof while cleaning the inwardly slanting windows, and accidents were not infrequent. Accordingly, tracks were laid along the windows and a trolley provided to run the entire length of the building. As the wheels of the trolley have ball-bearings, one man can easily move the vehicle along as he cleans the windows.

No machinery is now bought by the Steel Corporation without provisions for safeguarding all possible points of danger. In the two pictures of a bevel gear, which we illustrate, one shows the gears completely covered and all the oiling lids closed, while in the other the guards have been removed to show the gears, which were at one time uncovered and constant menaces to the lives and limbs of the workmen. The company's draughtsmen in designing new machines or making repairs for old machines have the safety idea constantly before them. They are required to make sure that all gears are covered, that all couplings are recessed, etc., and that every possible source of danger is guarded against. Every blueprint must be checked by a safety inspector in order to make sure that it comes within the regulations.

A common source of danger may be found in the ordinary planer with its open bed between the ways. The machinist who operates this planer is quite apt to use this space for storage purposes, and he is liable to have his hand caught by the table as he reaches down into the bed for something. We have heard of an accident in which a man stuck his head down into the bed in search of something, and the returning table promptly decapitated him. Accordingly the ruling has now gone forth, that the planer beds must be covered with sheet iron. Even the oil wells in a planer's ways must be covered. In one of our photographs may be seen the "skull cracker" with which large castings are broken up. The skull cracker is an enormous ball of iron which is lifted by an electromagnet. On demagnetizing the electromagnet the ball drops, striking the casting with a powerful blow. Flying fragments make this operation dangerous The customary barrier of boiler iron riveted to a steel frame has been found inadequate; for sometimes the fragments are thrown with force enough to cut clear through the barrier and injure people outside. This led to the erection of another barrier within the boiler iron wall, consisting of a series of iron tubes supported upright in a concrete base and filled with concrete, so as to form a stout stockade The force with which the fragments sometimes strike this stockade will be noted in the accompanying illustration by the dents made in the pipes. One of the pipes near the right-hand side of the picture will be seen to be cracked Unfortunately lack of space prevents us from illustrating the thousands of different safety devices, many of them exceedingly interesting, that have been developed in steel plants.

The organized safety movement of the United States Steel Corporation dates from 1906. In 1907 the rate of accidents was reduced to such an extent that 532 men were saved from serious injury. By the end of 1912, 8,801 persons had been saved. Surely this record shows that the work is worth while even if all humanitarian considerations be ignored.

The American Museum of Safety

(Concluded from page 114.)

by suction. The most striking part of the Pulmotor is a small leather accordion bellows, which effects the automatic reversal of the apparatus from suction to delivery, and *vice versa*, when essential. The bellows is connected with the air tubes. During inflation, the same pressure obtains in the bellows as in the lungs, and as soon as the latter are filled, the bellows becomes inflated, and in moving forward, causes the valve to be automatically reversed into position for suction. The operation is now reversed, and as soon as the lungs have been emptied, the bellows contracts and automatically reverses the valve again into position for inflating—and so on.

The medal was awarded for the fifth time last December to the Welin Marine Equipment Company for a chain of safety devices, including the Welin davit and the Lundin lifeboat. These devices have been fully described in the SCIENTIFIC AMERICAN for December 20th, 1913. Lifeboats are like a fire escape, they are wanted desperately when they are wanted at all, so that the boats themselves must be safely launched and kept afloat until succor arrives. The boats described in that issue fulfill admirably all the requirements of safe operation.

Such in brief is the history of the SCIENTIFIC AMERICAN Medal. The high class of the devices honored speaks well for the professional ability of the juries, the members of which have included some of the most eminent engineers in the country.

Proposed Improvement of the Patent Office

FOR many years the storage of the important records of the Patent Office as well as of the many copies of patents which have accumulated beyond all anticipation, has caused much concern. Many of the halls of the Patent Office are crowded with the accumulation.

It is now proposed to excavate the open court of the Patent Office to a sufficient depth below the present surface to provide a two-story storage place of about 15 feet, giving a headway of 7½ feet in each story.

The roof of the structure, so provided, is to be covered with soil and grass as at present with the walks covered with vault glass to admit sufficient light.

The intermediate floor of the storage place will be of metal grating so that light and air may circulate freely between the floors, and the Ninth Street end of the structure is to be made fireproof for the storage of the valuable records of the Office.

By leaving a space of seven or eight feet all round the court structure, sufficient ventilation may be secured and the structure adapted for the storage of patent copies and other records, but it is not contemplated that any part of the structure shall be utilized for work rooms.

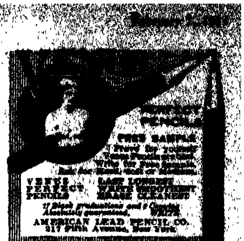
The appropriation of $220,000 to erect a building has already been granted, and it is now proposed to ask Congress to permit the use of this appropriation for the building of the vault space.

By the proposed arrangement all patent copies can be stored at one place, avoiding the distribution thereof throughout practically the entire Patent Office building as at present. This will facilitate not only the business of the Patent Office in securing the copies for its own use, but also facilitate the delivery of copies to attorneys and others in the transaction of business, while a perfectly fireproof compartment for the valuable records of the Office, at present exposed to fire risk, will be provided.

The Eruption of Sakurajima

ON January 12th the volcano Sakurajima, in southern Japan, burst into violent eruption. This volcano, which according to Naumann, was formed in the year 718 A. D., occupies the middle of the island of Sakura, opposite and a few miles distant from the large city of Kagoshima (the center of the Satsuma rebellion and of many other important events in the history of Japan). Both Kagoshima and the neighboring volcano are favorite resorts of occidental travelers. Sakurajima has had seven previous eruptions, all of them explosive, the latest in 1860. A much more violent one occurred in 1779; this produced such an impression that it has been commemorated locally ever since by a monthly festival.

The greater part of the people living on



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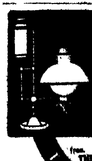

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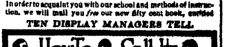

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HARRY P. STIMSON

[illegible] by the eruption [illegible] across the channel. About half of the 3,500 houses in the island were destroyed.

The eruption was accompanied by frequent shocks of earthquake, which, though not of extreme severity, did some damage in Kagoshima, and the city was also invaded by waves from the bay. Most of the inhabitants of Kagoshima closed their houses and fled. About twenty casualties occurred here.

After partially subsiding a renewal of volcanic activity occurred on the night of the 16th. Simultaneously with the eruptions of Sakurajima the volcano of Kirishimayama, lying about 30 miles farther north, was in eruption, and violent rumblings were heard from Aso-san, the largest volcanic crater in the world, belonging to the same group.

Prof. F. Omori, Japan's leading vulcanologist and seismologist, is quoted in press dispatches as having expressed the opinion that the whole volcanic range of Kiusiu has entered upon one of its recurrent periods of activity, and that other eruptions are imminent.

Dried Fruits and Their Use

IN the yearbook of the Department of Agriculture for 1912, there appears an article prepared by C. F. Langworthy on raisins, figs, and other dried fruits and their use.

To determine which of two fruits is really the more economical, says Mr. Langworthy, one should know not only the cost of each per pound, but also the amount of protein and energy a pound would supply, and should take into account the amount of material, fuel, and labor required to prepare the two foods for the table. Grapes commonly cost less per pound than raisins, but a given sum spent for fresh fruit will buy a smaller amount of nutritive material, since the proportion of water is much higher than in the raisins. On the other hand, one can think of circumstances under which low-priced fresh fruit, which may be eaten as purchased, would in the end be as economical as a somewhat cheaper dried fruit, since the latter would require sugar and fuel and time to make it ready for the table. Such considerations as the ease of obtaining a supply, convenience of use, the liking for a particular product, and many other things besides cost must also be taken into account in comparing dried with fresh fruits. Attention should also be directed to the question of refuse, or inedible material. If seeded and unseeded raisins cost the same price per pound, the former would be more economical as well as more convenient, since the purchaser would not have to pay for the seeds.

As a whole, dried fruits can be called reasonable in price as compared with other common articles of diet. This has been shown by numerous studies made in connection with the nutrition investigations of the Office of Experiment Stations. Some less general comparisons may also be made from the results of such studies. For instance, it appears that practically all the fruit products contain little protein, and as sources of this food constituent are so much more expensive than the cereals and dried legumes and most animal foods that there is practically no comparison between them. However, as sources of energy, derived almost entirely from their sugars and other carbohydrates, dried fruits are decidedly cheaper than meats, and compare favorably with dairy products, but are more expensive than cereals and starchy vegetables, such as dried beans and potatoes. When compared with one another, the differences in composition are relatively small, so that the selling price of different sorts of dried fruits is the main point when one is considering relative economy. This means that the housewife who wishes to economize can secure as much nutritive material from dried apples at a low price per pound as she can from a fancy grade of dried [illegible] at a much higher price per pound, though the flavor may not please her so well.

When every penny spent for food must bring the largest returns in actual nutritive value, questions of flavor and attractive appearance are of secondary importance, but when the income allows a range of choice, it is perfectly justifiable to consider them, and a family which can afford expensive meats and selected grapefruit can also purchase fine layer raisins for use as dessert, and fancy brands of other dried fruits. In the family where means are limited, the cheaper sorts must be chosen, but under any circumstances fresh and dried fruits should not be thought of as a luxury, since they may be used as an integral part of the diet to supply needed nutritive material, as well as add to the attractiveness and palatability of the daily fare. If they are to be eaten raw, care should always be taken to select brands which are made and marketed in a cleanly way, and most persons would prefer to pay a few cents more per pound, if necessary, to be certain that the brands are of this character. Dried fruits in sealed cartons or packages are much less readily soiled in market than those sold from open boxes. Unfortunately, neither price nor appearance is necessarily an index to cleanliness, and it is often difficult for the ordinary buyer to know where and how dried fruit was prepared and marketed. Those who are familiar with the facts in the case believe that the use of evaporators and other mechanical devices results in a much cleaner product than the old-fashioned methods, and that American dried fruits are the equal of any in this respect, and much more cleanly than those which are imported from Mediterranean regions. In using dried fruits in cookery every attempt should be made to secure clean, wholesome goods, to remove any bits of stem or other material accidentally present, and to wash the fruits before using them if they are not already clean. The heat of cooking will sterilize them, to be sure, but most of us prefer material which we do not need to sterilize to render it safe and wholesome.

Whether used by themselves as substitutes for fresh or preserved fruits, or mixed into cakes, puddings, confectionery, and other dishes, dried fruits offer a wholesome, nutritious, and economical way of securing variety in the diet, and are especially useful where the supply of fresh fruits is limited, or where storage space for fresh fruits is lacking.

Variations in Atmospheric Ozone

By Harry N. Holmes

THE existence of ozone in the atmosphere has often been disputed and the tests obtained ascribed to hydrogen peroxide, nitrogen peroxide and other compounds occasionally found in the air. Recent experiments, however, prove that variable amounts of ozone do exist in the lower air, though probably not more than one part in seven hundred thousand. The most conclusive test known is that with the so-called "tetramethyl base" paper. To be exact it is really tetramethyldiamidodiphenylmethane. A very small amount of this powder is dissolved in water containing a little acetic acid and strips of white filter paper are partly immersed in the solution. Ozone turns the exposed portions of the paper violet, while nitrogen peroxide turns it yellow, and hydrogen peroxide has no effect.

Various theories are advanced to account for the presence of ozone in the atmosphere. The electric discharge during thunderstorms is a favorite cause, though such an explanation is hardly in accord with the fact that in winter when there is very little thunder and lightning the air is richest in ozone. Besanez ascribes its formation to the rapid evaporation of water, yet other scientists insist that rapid evaporation of water in the sunlight produces hydrogen peroxide, thus accounting for the beneficial effects of sea air.

The most probable causes, however, are found in the silent electric discharge such as the aurora borealis and the action of ultra-violet rays of sunlight on cold, dry oxygen. Ladenburg and Lehman have

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shown that ozone has a number of absorption bands scattered over a wide range of the spectrum, and by a study of these bands Angström detected the presence of a large amount of atmospheric ozone. Naturally since little of it is found in the lower air it must lie in the upper air.

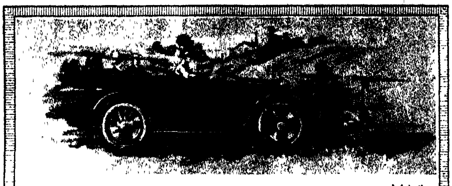
Humphreys demonstrated that a blanket of ozone around the earth would be much less permeable to earth radiations than to solar rays and must therefore act as a temperature regulator. Ultra-violet rays of sunlight undoubtedly convert oxygen into ozone, but, unfortunately for us, these rays are absorbed by air so that only a small fraction reaches the lower air. In the upper strata this ozonizing action is great, thus accounting for the presence of considerable amounts of ozone several miles above the earth.

It is evident that any decrease in the sun's radiation must be followed by a decrease in the formation of this ozone blanket, thus permitting more of the earth's heat to escape. Humphreys observed that sun spot maxima were always accompanied by a decrease in terrestrial temperatures many times that which could be accounted for by the decrease in radiation from the spot areas alone. A compensating effect in high latitudes is the action of sun spot maxima in increasing auroral displays, which in turn form increasing amounts of ozone. In equatorial regions there is no such compensation, so the upper air in the torrid zone must have a greater diathermacy to earth radiations. This results in the comparatively low temperature and great elevation of the equatorial isothermal air. This hypothesis is sustained by the facts, for the isothermal air in the tropics is two miles higher and 27 deg. Fahr. colder than in middle latitudes.

The theory and evidence given above receive further support from the weather observations of the author, carried on for a period of nearly two years. Only approximate measurements of the variations in the ozone content of the atmosphere were made, but this record is of considerable value. One of the most striking observations made was that thunderstorms—always supposed to form what little ozone the lower air contained—were really of minor importance in this connection. Any clear, snappy winter day will yield better ozone tests than the liveliest kind of a summer thunderstorm. Furthermore, since heat and moisture are unfavorable to the existence of ozone, the amount developed by summer lightning is quickly destroyed. Not so in winter, when the conditions for the preservation of ozone are frequently ideal—low temperatures and absence of dust after snows.

The whole series of tests studied in connection with the daily government weather maps proved beyond a doubt that the maximum ozone content of pure country air was found only when "high" barometric areas were so near that the air from great heights rapidly flowed down to the observer. Owing to greater extremes of temperature the storm areas are more frequent and intense in winter; hence the quicker transfer of high air to the surface. It is, of course, understood that "high" pressure areas are merely heaped up masses of air moving across the continent as regions of fair weather. The top of this heap falls and flows out in all directions from the center. The nearer the observer is to this center the greater the amount of ozone he finds in the air. If so far away that he is actually in a "low" area the winds blowing to him from the "high" will have traveled over a long stretch of the earth's surface, and the ozone beginning the journey will have been destroyed by moisture, dust, organic matter and, in some seasons, by heat.

These observations confirm the hypothesis that nearly all the ozone found in the lower air was made miles above the earth by the action of ultra-violet light on cold, dry oxygen. Naturally the quicker great bodies of this ozonized air fall to the earth the less chance there is for destruction of the ozone. Strong "high" barometric areas furnish these conditions. Such areas always produce cooler weather, and it may be objected that the



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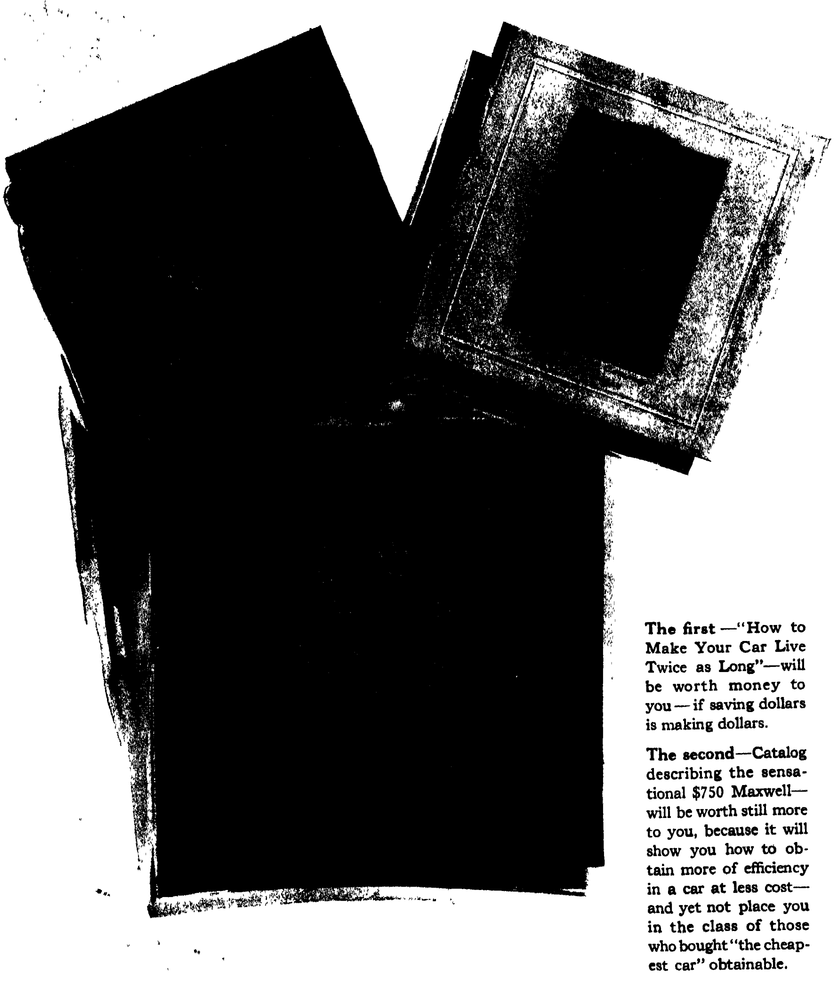

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preservative influence of low temperatures will alone account for the phenomena recorded. Such is not the case, for the coldest weather did not always produce the best ozone tests. On January 29th, 1912, Indiana (where the observations were made) was in a "low" pressure area and practically no ozone tests could be secured. The next day, January 30th, a powerful "high" area advanced from the Rockies and covered Indiana. The best tests of the year were obtained, although the temperature was only 21 deg. Fahr. *above* zero. On another day when the temperature was 30 deg. Fahr. *below* zero a very good test was secured, but still much inferior to that of January 30th.

Obviously the time to get out of doors is when the barometer is rising rapidly, even if the cold is intense. The treatment of tuberculosis patients in the Adirondacks hospitals, where they are pushed out of doors in the most severe winter weather, is justified. Such apparently cruel weather is caused by a rapid succession of "high" areas, and the accompanying ozone stimulates the nerves governing respiration and circulation.

The hot summer of 1911 was poor ozone weather. January and February of 1912 were remarkably fine (and it was an unusually healthy winter), the summer of 1912 much above the average summer weather, but this present winter has been rather poor in ozone—certainly much inferior to the previous winter. "What is so rare as a day in June?" might well have been asked of June, 1912, a month that, in the Middle West, brought more ozone than some winter months. June, 1911, deserved no poetic raptures, for it furnished very ordinary ozone weather.

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A METHOD has recently been introduced in Halifax, Nova Scotia, which promises to revolutionize the fish industry wherever carried on to any considerable extent, says Vice Consul General Eugene M. Lamb.

This process is based upon the theory that putrefaction of fish is first caused by bone taint, due to the fact that in the old methods of curing fish the specific or animal heat is partially left within the fish. The new method which has been introduced acts as a preventive to bone taint, completely removing the specific or animal heat from the fish to be cured.

Instead of salting, sun drying or shipping the fish in ice or refrigerating cars, the fish are dumped into a tank holding sea water which has been filtered through four cylinder-like tanks containing willow charcoal and screens to remove the noxious gases and foreign substances. Next, brown sugar is placed in the tank holding the fish to serve as a germicide for such organisms as may be active at freezing temperature. Then by refrigeration the temperature is lowered to 10 deg. Cent. below zero, during which time 16.1 per cent salt is added to prevent ice formation and to assist the formation of a thin protective coating over the fish themselves. Having allowed the fish to remain in this treatment for two hours they are ready for shipment, removed from the tank, and placed in the package or barrel to await transportation to market.

Antarctic Postage Stamps

AN interesting echo of Capt. Scott's antarctic expedition is the statement in the London *Times* that the British postal authorities are offering for sale all that are left of the special postage stamps issued for the benefit of the expedition, the proceeds to be used toward completing its work. Captain Scott was appointed by the government of New Zealand postmaster of Victoria Land, in the Antarctic, and Paymaster Francis Drake, R.N., assistant postmaster. There were, in all, three mails each way and one registered mail, carried by the "Terra Nova" from the base of the expedition in Victoria Land to New Zealand, or to other ships. All mails from the Antarctic bore the current penny and halfpenny stamps of New Zealand, surcharged. These now command at least 5 shillings and 25 shillings, respectively.

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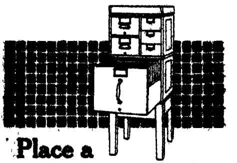

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Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12927) C. J. asks: 1. Does the speed that light travels vary in ether or a vacuum from its speed through the atmosphere? In calculating the distance of constellations and nebulae in light years is this variation in speed (if any) taken into consideration? A. The velocity of light in a vacuum, or the ether, is greater than it is in air in the ratio of 1 to 1.0003. This need not be taken into the account in determining the light years of the stars, because the air is only a few hundred miles in thickness at the most, and light requires less than a six hundredth of a second in traversing the earth's atmosphere. This is a vanishing quantity as compared with the time required for light to come from the nearest star. 2. Is the constellation known locally in Cuba as the "May Cross," because of its being visible better in that month, the true Southern Cross? What latitude farthest north can the true Southern Cross be seen at all from? A. The Southern Cross, the true Southern Cross, is highest in the evening sky in the month of May, so that it is seen farthest north on the earth in that month. Its principal star, α Crucis, is about 62 deg. south declination, so that it can be seen below 30 deg. of north latitude.

(12928) E. T. W. asks: We have men working at Bradley hammers, where the work is passed to them by a helper, so that they are compelled for hours at a time to look at metal near the white heat. We have provided heavy plate-glass shields to protect the men from flying sparks and hot scale. The writer has heard that mirrors have been constructed which were transparent from the back. The idea has been advanced that such a mirror could be used in this case and would reflect a large amount of the heat, at the same time enabling the operator to see the work. Have you ever published anything on the subject of making such a mirror? Do you know who could furnish such mirrors? A. Glass is silvered for mirrors and such a coating may be put on that it will be quite transparent, but will reflect much heat and light, thus to a degree protecting a workman who stands behind it. This process is described in our Supplement 1671, which we will send for ten cents. Should you wish to get a large plate silvered, you can probably have it done by John A. Brashear, Allegheny, Pa. This firm makes mirrors for telescopes. Perhaps the Pittsburgh Plate Glass Company could do the work cheaper.

(12929) C. W. P. asks: I shall probably soon need a camera for work in which a low-priced lens would be sufficient, however, there is a possibility that I may want to make stereopticon slides from the negatives, and would like to know your opinion as to what kind of camera lens would be satisfactory for such work. A. For making lantern slides a negative 3¼ x 4 inches is most convenient, since the slide can be made by contact, and a copying camera for reduction is thus rendered unnecessary A camera taking a picture of this size, 3¼ x 4 inches, is all that is required for making lantern slides, and the adjustment of the picture to the size of the opening of the mat, about 3 x 3 inches at the largest, can be made when the picture is taken. Now as to the lens, it is not good economy to use a cheap lens The better the lens the better the work, the sharper the focus, the flatter the field, and the focus at the edges of the field. With a cheap lens the edges of the field cannot be in as good focus as the center. You would better have a cheap, home-made camera and a good lens than the best camera and a cheap lens.

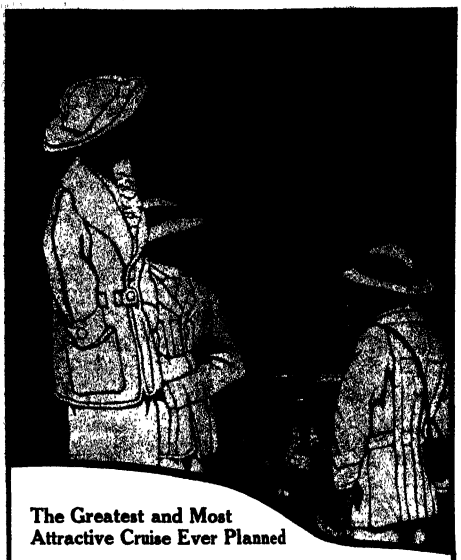
(12930) E. F. asks: I am in receipt of your letter of November 19th, and note that you say that "the air nearby may be somewhat above 32 deg." As a matter of fact, I have seen frost when the temperature of the air several feet above ground was as high as 36 and 38 deg. Several nights during the early fall, when the temperature did not go below 36 deg., there was still a heavy covering of frost, due to the rapid radiation of heat from the ground, and the consequent lowering of temperature of the dew below the freezing point I wanted to know whether any experiments had been made to determine whether frost formed at a still higher temperature than that observed by me. I desire to thank you for your reply to my last letter, and if you have any further information on the subject, kindly advise me. A. As we wrote you before, the temperature at the point where frost forms must be 32 deg. Fahr. What the temperature may be a few feet or a few inches away no one can say. The air is a non-conductor of heat. If the air is still, it may be higher than 32 deg. very near the place where frost is forming. We have many times formed frost in a room where the thermometer was above 70 deg. Fahr. by evaporation of a volatile liquid. If the air is in motion the temperature in the neighborhood of the frost will not differ perceptibly from 32 deg. Fahr. We do not see how any exact statement of temperature as you desire can be made.

(12931) G. T. S. asks: A friend of mine has an agate which he found on the Oregon coast, and one surface of which he has had polished. There is an opening in the agate about an inch long, and this opening is partially filled with water. Will you kindly let me know through your Notes and Queries columns how this water got inside the agate? A. The mode in which an agate is probably formed will explain the occurrence of water included in some of these stones. It is probable that there existed a small pocket or crack in the rock. Water holding silica in solution worked its way into this cavity and deposited a layer of silica. This was repeated for a long time, until the agates in layers resulted. If the agate formed in a spherical or rounded cavity, the result might easily be that water would be inclosed in the completed stone The water might be nearly invisible if the cavity was completely filled; but if a space was left unfilled, the water could be seen as the stone was shaken. This is the theory held by mineralogists to account for the frequent inclusion of water in such crystalline stones.

(12932) L. G. B. asks: Given one large jar of water, and another of mercury, both at the same temperature, and immerse in each the bulb of a thermometer cooled to 20 degrees below the temperature of the water and mercury, will the temperature of both thermometers rise 20 degrees in the same time? A. The thermometer will rise more rapidly in mercury than in water. Mercury is a metal, and metals are better conductors of heat than are the non-metals. Indeed, water is one of the poorest conductors of heat. It is usually heated by convection. 2 Will you please give an exact and absolute definition of temperature? I have an elaborate modern treatise on heat, the first chapter of which is devoted to temperature, without, however, defining it. A. Temperature is the thermal condition of a body which determines the transfer of heat between it and other bodies. It is therefore the relative intensity of the bodies in relation to sensible heat, or heat which can affect a thermometer. Absolute temperature is simply temperature as referred to the absolute zero of the scientist. 3. Is it settled beyond dispute that a gas does not fall in temperature in expanding unless it does work? If so, what is the proof? A. It seems to be settled that a perfect gas would not fall in temperature in expanding. But a perfect gas is hard to find. Most gases are imperfect and are cooled slightly in expanding. Hydrogen is a pluperfect gas and is not cooled sufficiently by expanding Joule and Thomson's experiments are described in Poynting and Thomson's "Heat," page 296, "Internal Energy Taken Up by a Gas in Expanding" We will send the book for $4.25 postpaid. 4. If it does lose heat in expanding without doing work, what becomes of the heat? A The heat is used up in doing the work of expanding the gas, if it is lost from the gas 5. Does the statement that it takes nine times the quantity of heat to raise the temperature of a pound of water one degree that it takes to raise a pound of iron one degree, mean that all the heat applied in each case is completely absorbed? Or does it mean that the heat passes through and out of the water with only one ninth of the effect upon its temperature that it has on the iron? A. The specific heat of a substance is the quantity of heat actually required to raise a unit weight of that substance one degree as compared with the amount of heat required to raise unit weight of water one degree. The heat must all of it be absorbed by the substance. Iron will be heated about nine degrees by the quantity of heat which will heat the same weight of water one degree. Excepting hydrogen, water has the largest specific heat of any substance

(12933) E. F. S. asks: I would like to ask through your paper in regard to generating acetylene and under what pressure it will liquefy, and if any danger in using plunger pump to compress same? A. Acetylene is best generated by dropping the calcium carbide into a large quantity of water, since the heat of the chemical action is then taken up by the water. It cannot be liquefied at a temperature above 98 deg. Fahr At this temperature a pressure of 68 atmospheres, 1,020 pounds per square inch, is required to liquefy the gas. At the freezing point a pressure of 21.53 atmospheres, 323 pounds per square inch, will liquefy the gas. The explosions, which resulted in loss of life, from compressing the gas in cylinders, together with other troubles, stopped this mode of using it. At the present time it is dissolved in acetone, which will dissolve twenty-five times its own volume of acetylene at atmospheric pressure. It has proved safe to pump it into acetone You will find the information you require in Leeds and Butterfield's "Acetylene," which we send for $2.75 postpaid.

(12934) W. H. D. asks: At what temperature does water commence to expand before freezing condition exists, and up to what temperature does it get when ice forms? What is the comparative pressure per square inch of this expansion? A. The temperature of the maximum density of water is 4 deg. C., and from that temperature the water expands till at 0 deg C. it begins to change into ice. The corresponding degrees in Fahr. are 39.2 deg. for maximum density, and 32 deg. for the freezing point. The force of the expansion of water as it turns to ice is nearly 2,000 atmospheres. The volume of ice is about 0.09 greater than that of the water from which it is formed. Water is compressed 46 millionths for each atmosphere. To compress water 0.09 will therefore require 1,950 atmospheres. This is over 29,000 pounds per square inch.



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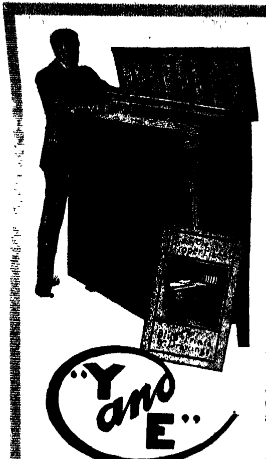

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THE ELECTRIC VEHICLE HAND-BOOK. By H. C. Cushing, Jr. and Frank W. Smith. New York: H. C. Cushing, Jr. 16mo.; 356 pp.; illustrated. Price, $2 net.

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CHIPPEWA MUSIC. II. By Frances Densmore. Smithsonian Institution, Bureau of American Ethnology, Bulletin 53. Washington: Government Printing Office, 1913. 8vo.; 341 pp.; illustrated.

Bulletin 53 is a supplementary volume to Bulletin 45, and continues Miss Densmore's studies of Chippewa, or Ojibwa, music, particularly in its relation to tribal life. There are songs of their games and their dances, songs "composed in dreams," and those of the famous drum-presentation ceremony are given, with description. In the present volume the melodic and rhythmic analysis of the music is continued. The Rev. C H Beaulieu, a member of the tribe, is responsible for the analysis of the words and for a part of the translation

HAND-BOOK OF TEXTILE CORPORATIONS. 1913. New York. Frank P. Bennett & Co., Inc. 8vo.; 744 pp.

The hand-book is compiled for the benefit of three classes of readers—the bankers, the brokers, and the investing public—and is sold with the understanding that purchasers may make unlimited inquiries about the finances, equipment, production, etc., of the listed mills. The work is a co-operative compilation, in that it has received information and aid from bankers and from the manufacturers themselves The result is an authentic reference volume giving the location, capital, officers, production, power, and markets of every textile mill in the country

PRACTICAL USES OF THE WAVE METER IN WIRELESS TELEGRAPHY. By J O. Mauborgne, First Lieutenant 24th U. S. Infantry New York: McGraw-Hill Book Company, Inc., 1913. 8vo.; 74 pp.; with diagrams. Price, $1 net.

The basis of this work has been used as a reference text at the Army Signal School, Fort Leavenworth, Kansas, but in its amended form it is very well adapted for use in commercial and technical schools The book describes the types of wave meter used by the U S Signal Corps, explains how the meter is used as a receiving set, in measurements with the helium tube, and with the telephone, or galvanometer, and detector, and deals with sending-station tuning The final three chapters go with great detail into the measurements of damping, wave lengths, capacity, and inductance

ADVERTISING AND SELLING. Principles of Appeal and Response. By Harry L Hollingsworth, Instructor in Psychology in Columbia University; Lecturer in Business Psychology, School of Commerce, New York University. Published for the Advertising Men's League of New York City, Inc New York: D. Appleton & Co., 1913. 8vo.; 314 pp.; illustrated. Price, $2 net; by mail, $2.16.

We have often wondered why there was such a comparative dearth of books on the finer principles of advertising and salesmanship. Here is one that attacks the problem at its root, along known psychological principles dealing with and governing the arrest of attention Far from being academic, however, the work is intensely practical, and demonstrates its contentions by actual examples of present-day advertising. It goes further. It takes these examples and tabulates for us their results It takes various advertisements of the same goods, with the number of replies each brought, it thoroughly considers the incentives—mechanical and interest-catching Colors, types, relevant and irrelevant illustration are dwelt upon in their relation to attracting and holding the interest. No phase of the subject, no matter how remote or subtile, seems to have been overlooked The suggestions of the work should in many instances lead to a large increase of efficiency in the advertising and selling department.

GRAPHICS AND STRUCTURAL DESIGN. By H. D. Hess, M.E., Professor of Machine Design, Sibley College, Cornell University. New York. John Wiley & Sons, Inc., 1913. 8vo.; 428 pp; 429 figures. Price, $3 net.

This is a Cornell University text, in which the subject of structural design is broadly treated, the problems linking civil and mechanical engineering. The determination of stresses, it may be stated, is by no means confined to graphical means, as the title of the work might imply. The inclusion of a plate-girder railway bridge, though somewhat foreign to the spirit of the work, nevertheless serves the purpose of clarifying certain questions as no other illustration seems to do, besides pointing the use of the moment table. The volume may also find a field of usefulness as a reference book for designers.

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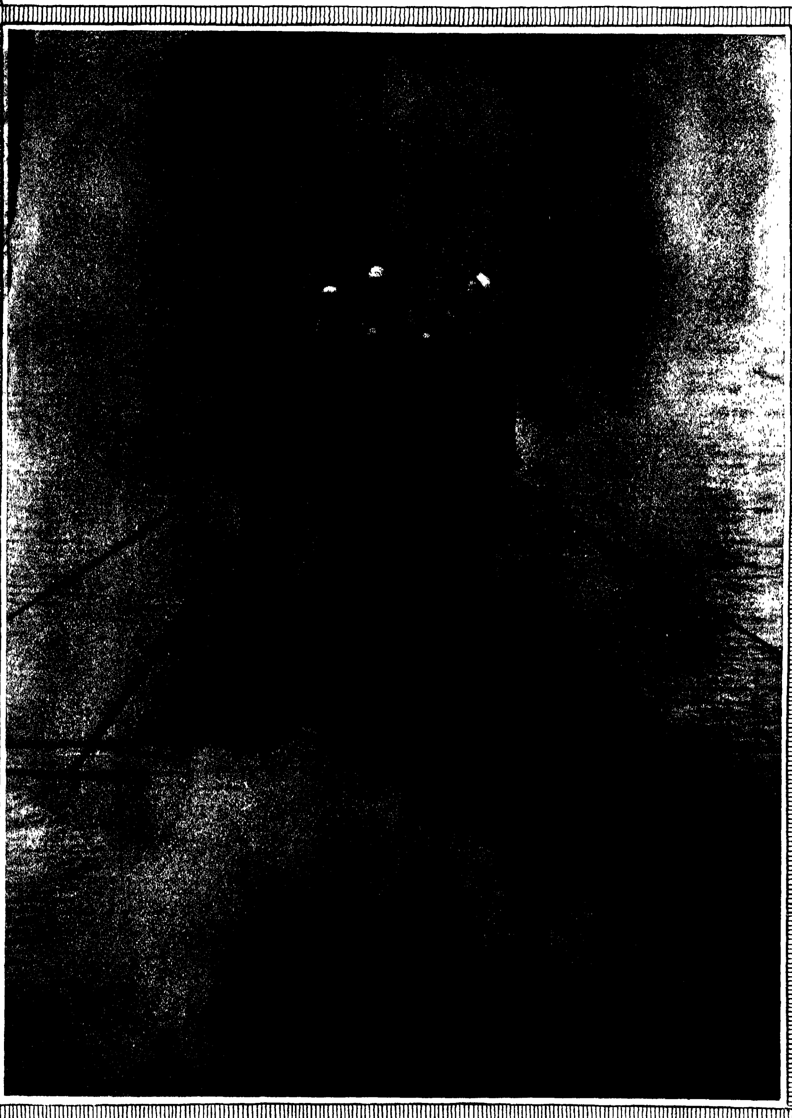

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Vol. CX. No. 7
[illegible]uary 14, 1914

Munn & Co., Inc., Publishers
New York, N. Y

Price 10 Cents
$3.00 A Year

Cadillac
Standard of the World

Public attention is focusing upon one car

and especially upon a principle in that car which distinguishes it from others

Public attention is focusing upon one car, and especially upon a principle in that car which distinguishes it from other cars

The car is, as you will surmise, the Cadillac; and the principle is its two speed direct drive axle.

Partly because of that principle, the Cadillac rides differently, and, it is said, more luxuriously than most other cars.

The sales arguments of other makers tend to draw public attention in another direction—toward the more conventional types of construction

And in spite of that powerful influence upon public opinion, in Europe and in America—professional and public interest insists on returning to the Cadillac and its two speed direct drive axle

This is only logical—it is merely Cadillac history repeating itself, as in the three other memorable cases in which Cadillac progression altered the trend of motor car practice

The present tremendous interest in the 1914 Cadillac and in the splendid performances of the car can be traced directly to its source.

To begin with, more than 8,500 owners are now driving the 1914 Cadillac

More than 8,500 people expatiating with unbounded enthusiasm, day after day, upon the unique riding qualities resulting from the latest Cadillac development, are stimulating the keenest interest, even among those driving other cars

And this process growing and growing in volume, since the first of the new cars appeared last summer, received a pronounced impetus several weeks ago

The second award of the Dewar Trophy to the Cadillac was an extraordinary endorsement

Coming from the highest professional tribunal of its kind in the world—the Royal Automobile Club of Great Britain—it confirmed every Cadillac owner in his conviction that there never have been such riding qualities in any car

THE DEWAR TROPHY

That is exactly what Cadillac owners are saying—what the first owner you meet will say to you.

And these two things—the zealous partisanship of more than 8,500 owners rendered still more zealous by the Dewar award—are being accentuated by press comment at home and abroad.

That is why the united volume of attention attracted by other good cars and other good principles of construction have not been able to distract attention from this one car with its peculiar principle.

That is why American and European journalists are venturing to predict that the Cadillac has impressed a fourth indelible imprint upon the industry as a whole.

World-wide interest has been aroused by a plain and indisputable fact—that the sensation of riding in the new Cadillac is almost like the sensation of floating through space

All the technical and professional discussion in the world will not alter that extraordinary and delightful fact.

That is why we are impelled to caution you again.

If you wish to guard against disappointment, don't delay ordering your Cadillac.

You have been told the same thing, year after year. And year after year, with an annual increased production, the Cadillac supply has fallen short of the demand

If the qualities which won the Dewar Trophy—the qualities over which Cadillac owners are so ardently enthusiastic—the qualities which have become a topic of world-wide interest—are qualities worth getting in a motor car—see your Cadillac dealer at once.

Because these qualities are peculiar to the Cadillac

They flow out of Cadillac standardization, Cadillac methods, Cadillac ideals and the Cadillac two-speed direct drive axle.

It is these qualities, in short, which constitute the Cadillac the "Standard of the World."

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		Standard Touring Car, five passenger	$1975.00		
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SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, FEBRUARY 14, 1914

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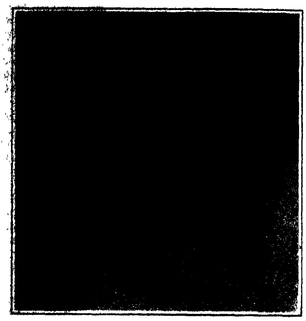
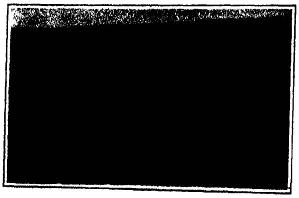
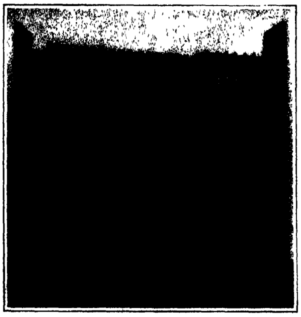
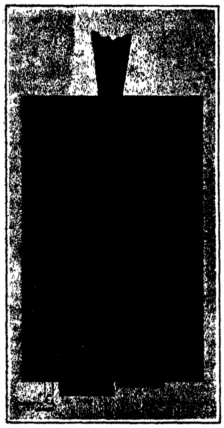
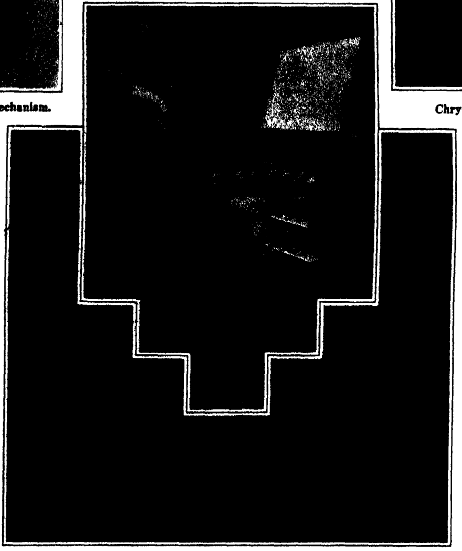
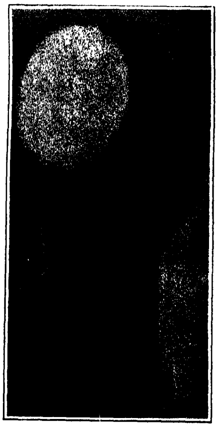

Tubular bells with electric striking mechanism.


Expression box with electrically operated shades.


Chrysoglott with electric attachments.


Cross-section of wind chest and electro-pneumatic mechanism.


The inventor seated at movable console.
Wind chest with pipes.


Tambourines with vibrating device.

The Hope-Jones Unit Orchestra

By Moritz A. Jägendorf

IT took over twenty-three years to accomplish the work that changed the functions of an organ into that of an orchestra, and yet it appears to be very little when we consider for a moment the result. Thousands have listened to the unit-orchestra night after night in the New York Century theater, in the Cort theater of Chicago, and in perhaps ten more places in different parts of the country; also orders are said to have been received for many more in a number of States. The inventor of this wonderful instrument is Mr. Robert Hope-Jones, the famous electrician and organ builder of England.

Mr. Hope-Jones began his experiments as a hobby, and though it has now become his life work he still looks upon it with the same fondness as the one who does work for sheer pleasure. Naturally, he commenced this work on the organ. He began by placing all the movements in the organ under electrical control. This very soon showed that he could secure an action on the instrument that far exceeded the ordinary movement. But this did not satisfy him. As a musician, he felt that the musical qualities of the organ were not what they might be, and he therefore set out to improve them. Very soon he had a new invention that made possible a finer quality of tone and a larger variety of timbre. This was an apparatus for photographing sound waves in the atmosphere. With photographs of every conceivable instrument in every conceivable variety of tone, it was a comparatively easy matter to reproduce pipes whose notes were, if not exactly identical with those of the original, very near them. And when the percussive instruments that worked in harmony with organ pipes were added, it enabled the player to absolutely control the expression by hand and foot. It was now possible to reproduce the tones of the very finest musicians and the control of the instrument and its rapid action permitted the operator to produce music such as we associate with the very finest orchestras.

Previous to that Barker, an Englishman, had also worked out an arrangement that would control the speech of the organ by means of electricity, and had taken out patents covering his device. He also attempted, two or three times, a practical application of the invention both in England and in France. There were a few other organ builders who made similar attempts, but all of their inventions proved to be unreliable in action and soon fell into disfavor. The electro-pneumatic action invented by Mr. Hope-Jones was absolutely successful and popularized this method of control. It differed from the others, not so much because of a departure from the principle, but on account of the scientific perfection of its details.

On examining the Hope-Jones unit orchestra, there will be found first of all under every pipe, a long rectangular *valve A* set in a chest *B* that is supplied with compressed air furnished by means of a rotary fan driven at a speed of about 1,000 revolutions per minute. These valves are hinged on a pin *C* and are normally kept in their closed position by means of a wire spring *D*, as well as by the pressure of the compressed air in the chamber *B*. There is also a pneumatic bellows *E* so arranged that when closed it will, by means of the arm *F*, open the pallet or valve *A*. Under normal conditions the compressed air in the wind chest finds its way through the passages G^1 and G^2 into the interior of the pneumatic motor *E*, but when the double valve attached to the spindle *H* is raised the passage G^1 becomes closed and the compressed air within the motor *E* escapes to the atmosphere through the passage G^2. The pressure of the air in the wind chest *B* then collapses the pneumatic motor *E*, and by thus opening the valve *A*, allows the compressed air to escape by way of the chamber *I* into the organ pipe *J*.

(Concluded on page 150.)

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

More Information for the House Committee

ASSISTANT Secretary of the Navy Roosevelt, in a recent conversation with half a dozen captains of the United States Navy, asked them which they would rather command in the event of a fight between one "Wyoming" and ten "Oregons" Five of the six said they would prefer to take the "Wyoming." The sixth thought that he would take his chance with the ten "Oregons" because the one "Wyoming" *might* blow up Now this unanimous choice of the "Wyoming" was made for readily understood reasons The twelve 50-caliber 12-inch guns of the dreadnought would greatly outrange the old 35-caliber 13-inch guns of the "Oregons;" and the superior speed of the modern ship of 21 knots, as against the present speed of, say, 14½ knots of the "Oregons," would enable the "Wyoming" to maintain a distance of ten or twelve thousand yards, well beyond the effective range of the old 13-inch pieces, and silence or sink the ten "Oregons" one by one, or three or four at a time for that matter

It is considerations such as these that have led the naval powers to disregard the pre-dreadnought battleship, in estimating the strength of the first fighting line of modern navies, and it was sheer ignorance of these facts that led Mr Witherspoon of Mississippi in his recent examination of Secretary Daniels before the House Naval Affairs Committee, to make the ridiculous statement that the United States Navy is to-day superior in fighting strength to that of Germany, and also led him, alas! into a discreditable effort to repudiate the Navy Department's estimate of our relative battleship strength and charge our naval officers with having made a deliberately misleading comparison

The figures of dreadnought strength given in our editorial of December 20th, 1913, on "The Decline of the United States Navy," are perfectly correct When the ships now building are completed, England will have forty-two dreadnoughts, Germany twenty-six, and the United States twelve To-day, not even a dreadnought is considered fully available for the first fighting line, unless she has a speed of twenty knots or over, and if, when the ships now building are completed, we can put into our fighting line only twelve such ships against the twenty-six of the German navy, the enormous superiority of their first line of battle is established beyond all question

In pre-dreadnoughts, we are perhaps more powerful than Germany; but these, in the event of a first-class engagement, would on both sides be held as a reserve; no wise commander-in-chief would put them into the first line of battle, where they would hamper a dreadnought action by their much slower speed, their comparative lack of big long-range guns, and their comparative inability to withstand the gun and torpedo.

Germany could pit twelve dreadnoughts against our twelve and hold in reserve her other fourteen dreadnoughts; which later would enter absolutely fresh into the fight and quickly turn any advantage our fleet might have gained into crushing defeat

It is best to look facts squarely in the face, and realize, once and for all, that the opposition to warship construction of the past few years in Congress has meant the cutting down of construction at the very time when we should have been most active in meeting the new conditions presented by the evolution of the dreadnought. *It is this fatuous policy which has relegated* us to the position of a third-rate naval power Secretary Daniels, in the recent hearing, took a firm stand in favor of two battleships; indeed, if he is correctly reported, he stated that if he believed Congress would make the necessary appropriations, he would be in favor of recommending the construction of four battleships this year.

Bold international policies and an adequate dreadnought fighting line go hand in hand; and at no time were our policies so bold or so fraught with stupendous possibilities as to-day. Consider them: The Monroe Doctrine; the open door in the East; the integrity of China; Asiatic exclusion; and the preservation of the neutrality of the Panama Canal.

Flying Around the World

A FIRST PRIZE of one hundred thousand dollars for a trip around the world in an aeroplane! It seems worth winning. But is it?

An air journey of such length, a journey fraught with undreamed-of perils, may not be lightly undertaken—certainly not without much experimenting. Fifty thousand dollars would be a modest sum indeed to spend in designing, building and testing a machine, capable of flying around the world. Another $50,000 and more would probably vanish in dotting the globe with repair stations and fuel depots, each manned with highly paid mechanics And so the venturesome aviator would have to content himself with the $50,000 offered by Lord Northcliffe for a trans-Atlantic flight, a prize which he would also win by flying around the world. Even if his expenses were only $100,000, the winning of the Northcliffe prize would seem a wofully small reward for months of arduous preparation and ninety days of grave personal risk.

The Panama-Pacific Exposition directors must surely have realized all these difficulties, and so must the editors of the newspapers who have published yards *of printed matter on this romantic proposal.* Anyone with but an elementary knowledge of aviation, anyone who has read the difficulties that Védrines encountered in flying to Constantinople (German objections to flying over fortifications, the great wind surf of the Taurus Mountains, the shots of an ignorant, half civilized peasantry) must know that at the bottom of all this talk of flying around the world is a desire for so much free publicity

Suppose the feat could be performed What would be the good of it? It would not convince the tired New Yorker that the day is at hand when he may trundle out his monoplane as readily as his automobile and serenely soar off to some sanitarium in the Himalayas, where he may recuperate, thousands of miles from the bewildering attractions of a metropolis. Technically considered, the long trans-European and trans-Mediterranean flights recently made in Europe added only to the newspaper reputation of a few aviators, hungering for applause, but nothing to the technical advancement of the flying machine.

How much might be accomplished with the $300,000 so temptingly dangled in front of the noses of aerial acrobats! A whole aerodynamic laboratory might be built; a wonderful and highly instructive series of much needed experiments might be conducted which would illuminate the dark subject of aerial propellers; *an extremely valuable investigation of aeroplane motors* might be made, as proposed in last week's SCIENTIFIC AMERICAN. But of all this constructive work, of any true desire to develop the aeroplane so that it may become as safe and sure as the safest and surest of land vehicles—of all these wonderful opportunities not one is seized. Assuming that a supremely self-confident pilot seated at the wheel of a superbly constructed aeroplane, actually circumnavigates the globe, what will the world, the aviator, and the Panama Exposition be able to show for $300,000 spent to make an aviation holiday? Nothing but a battered machine and a battered man.

Early Developments in Naval Gunnery

A COUPLE of hundred years ago almost any ship capable of keeping the sea could be utilized as a man-of-war, and the simplicity of the armaments permitted a ready instruction of crews in the use of their weapons. It was customary, however, to build vessels specially for the purpose of fighting at sea. Ships of the line were constructed to carry heavy armaments and had thick sides to keep out the projectiles of those days. The discussions as to types best adapted for the various purposes of war were just as keen then as now

In fighting at sea it became customary to fire broadsides, or salvos, in order to permit the smoke to clear away before the next discharge, and to gain the advantage that the shock of the simultaneous impact of many projectiles produced on an adversary. The fighting was necessarily at close range, and positions of advantage were sought. That from which a raking fire could be delivered was the most to be desired, as from such a point a broadside could be opposed by but few guns mounted in the bow or stern of an enemy.

In the many histories of battles and of voyages published in those times, frequent [illegible] the methods in vogue of gunnery, target [illegible] tactics, all of which were matters of the [illegible] est at a time when fighting was not an [illegible] of a mariner's life. In fact, it would [illegible] state that naval gunnery was a matter [illegible] terest to the public at large at that [illegible] to-day.

In an account of Anson's wonderful voyage around the world in 1741-2-3, a description [illegible] taking of a Spanish galleon, off the Straits of San Bernardino, while on a voyage from Acapulco to Manila. The author tells of the gunnery methods [illegible] this occasion to defeat the Spaniards, [illegible] to fire broadsides and to lie flat on deck [illegible] ing a salvo from an enemy. Anson, who was short handed, surprised the crew of the [illegible] sion, and, greatly to their discomfi[illegible] individually and in succession. Pick[illegible] piece to piece for the purpose of dire[illegible] them, while the guns were loaded b[illegible] solely for that purpose. The smooth[illegible] period were fired point blank, by m[illegible] match and the use of the powder hor[illegible]

Rodney's memorable victory of Apr[illegible] been ascribed to the flint locks fitte[illegible] the "Duke," out of his own funds, b[illegible] that vessel of the previous year. The [illegible] this ship forced the opening of the ga[illegible] line which so materially contributed t[illegible] that occasion.

Shortly after this time "quarter sight[illegible] guns. These were marks engraved on [illegible] base ring of the piece. Graduations [illegible] degrees from point blank to an eleva[illegible] three degrees, and they permitted a rou[illegible] for a variation in range.

During the War of 1812 the guns of Am[illegible] were generally fitted with adjustable sights. British authorities of this period have ascribed the successes of their adversaries at sea to this feature, as they themselves had not then adopted those devices, which were considered to be objectionable because of the probability of their fouling the ropes and gear of a sailing vessel, and because of the large port openings made necessary by their use. The "Shannon," at the time of her victory considered to be the best gunnery ship in the British service, was a notable exception to the British rule, and had adjustable sights. During this conflict several actions resulted in American [illegible] because of the fact that our vessels were generally armed with long guns which permitted an accurate fire when our ships were still beyond the range of the shorter weapons of our enemies.

The smoke of the discharge of salvos was a great detriment to rapid gunnery then as now, smokeless powder having diminished but not entirely eliminated this difficulty. In order to overcome this obstacle, and to permit firing when the ship rolled in a seaway with the target close aboard, but shrouded in smoke, an ingenious expedient of utilizing a large pendulum hung in the main hatch was adopted. A system of signals or orders was devised as a part of the fire control scheme by means of which directions were given regarding the proper angle of elevation for the lee guns, or of the depression necessary for those of the weather side, which enabled the guns of the broadside or broadsides that were engaged to be fired when horizontal. This device was also used by the British frigate "Shannon" during the War of 1812-13.

The always highly technical French gunners improved the pendulum idea by checking the indications on this apparatus by means of a reflecting instrument showing the coincidence of the real and reflected horizon at the instant at which the axis of the gun became horizontal.

The advent of the rifled gun, which permitted greater accuracy and penetration of the projectile, was a great step in advance for gunnery as well as ordnance. Iron breech-loading rifled guns for discharging shell were invented in Europe in 1846. The adaptation of breech loading to rifled cannon permitted greater ease, safety, and speed of loading and greatly improved the accuracy of fire, and was another great advancement in the science of gunnery.

Another important stride from the standpoint of ordnance was the invention of the turret. The turret was first given a practical trial on board the "Monitor" (built by Ericsson) in her historic battle with the "Merrimac" at Hampton Roads, and it is distinctly an American contribution to the naval art. The advantages of turrets were that they afforded a good protection and provided a wide arc of fire for the gun. Out of the turret has grown the "dreadnought."

The naval telescope sight, invented by Lieutenant, now Rear Admiral, Fiske, and demonstrated by him at target practice in 1892, was a most important improvement in naval ordnance. The telescopic sight, the range finder and the spotter have made possible the marvelous accuracy of modern long-range shooting.

Engineering

Bering Coal Fails in Test.—Coal taken from the Bering River field in Alaska and tested in the American navy to determine its fitness was a complete failure. This has proved a great disappointment to officials of the navy, who realize that the results of these tests have an important bearing upon the question of the future coal supply of the navy in Pacific waters.

Oil Supply for the Navy.—With only a portion of the fleet equipped to burn fuel oil, the navy is now using 30,000,000 gallons of fuel oil per year, and, according to the Secretary, the time will soon come when the annual amount required will be 125,000,000 gallons. It is proposed to establish tanks at various ports and strategical points; and a special board is investigating the oil lands of the Osage Indians in Oklahoma with a view to their purchase for naval supply.

France to Build 16-Gun Dreadnoughts.—On January 1st, 1915, the French Admiralty will commence the construction of four super-dreadnoughts of about 29,000 tons, which will each carry sixteen 13.4-inch guns in four quadruple turrets. These ships will be able to fire eight guns ahead, eight astern and sixteen on each broadside. The French believe that these ships will be superior to the British "Queen Elizabeth" type, which can concentrate half the number of 15-inch guns in the several directions of fire, or four ahead and astern and eight on each broadside.

Canal Excavation in December.—The grand total of canal excavation to January 1st, 1914, was 215,458,272 cubic yards, leaving to be excavated 16,894,728 cubic yards. The total excavation for the month of December was 1,581,726 cubic yards. In the central division, including Culebra, the total was 860,429 cubic yards, of which 161,000 cubic yards was removed by steam shovels from the top of the banks of Culebra cut in the zone of the slides, in order to relieve pressure, 417,807 cubic yards were taken out of the slides, and 141,000 cubic yards removed by the Culebra sluicing plant.

Perilous Railroad Track.—The Interstate Commerce Commission's report on a derailment on the St. Louis & San Francisco Railroad revealed abominable conditions of the track at the point of derailment. Says the report, the state of the track "was such as to constitute a dangerous menace to the operation of trains in safety." At a rail joint near the point of derailment three spikes were so loose they could be removed by hand, and two rail joints were bolted on one end only. Nine hundred feet east of the point of derailment a rail section was found, under which ten out of the twenty ties were decayed, and a total of thirty spikes were removed by hand from the ties under this rail section alone. Could matters be much worse than this?

Proposed Navy Armor Plant.—The Chief of the Bureau of Ordnance, Rear-Admiral Joseph Strauss, submitted figures to the House Committee on Naval Repairs showing that to build a plant for the construction of armor with a capacity of 16,000 tons a year would cost about $11,000,000. The above-mentioned amount would be necessary if the standard of two additional battleships a year were followed. The witness stated that the construction of this plant would be a wise policy, since it would have the effect of enabling the Government to control the price of armor. Secretary Daniels is of the opinion that there is a "gentleman's understanding" among the armor-plate makers of the world to keep the price up to its present figure of something less than $500 per ton.

Deep Waterway from Montreal to Duluth.—The Government is favoring a discussion, through the International Joint Commission, of the proposal for joint construction by the Governments of the United States and Canada of a deep waterway for ocean-going steamers from Montreal to Duluth, Minn. The matter will be taken up first with the Canadian government. Various routes are proposed, costing from $100,000,000 to $300,000,000. The route favored provides for the utilization of all the lakes and of the St. Lawrence River. Shipment of the products of the Middle West from lake ports to the Atlantic coast and foreign ports, and a similar shipment of return cargoes, would be of vast benefit in reducing rail rates and improving rail facilities from all points to the ports affected.

A Ridiculous Proposal.—We are surprised to note that our staid contemporary, the *Tribune*, devotes nearly half a column to a statement sent "by telegraph to the *Tribune*," in which it is seriously affirmed that a Denver architect proposes to lift the "Titanic" by means of a multiplicity of magnets. A submarine is to be sent two miles down into the depths of the ocean, where it will direct the attachment of "powerful electric magnets" to the hull of the sunken ship. From these magnets light steel cables will lead to wrecking ships two miles above, at the surface. Here steam winches, when all is ready, will proceed to wind up the ill-fated ship and bring her to the surface. We think the technical editor must have been away from this desk when this Denver telegraphic dispatch found its way into print.

Science

An International Conference on Phytopathology is to be held in Rome February 24th, 1914, in accordance with arrangements made by the French government.

Destructive Earthquake in Peru.—An earthquake at Abancay, in southern Peru, on November 7, is reported to have destroyed many villages and entailed a loss of 200 lives.

The Centenary of the Discovery of Iodine was celebrated at Dijon, France, November 9. A commemorative tablet is to be placed on the house in Dijon in which Courtois, the discoverer of this element, was born.

The British Antarctic Expedition of 1914, under J. F. Stackhouse, will have a scientific staff of 40 or more, including two surgeons, two physicists, two geologists, an oceanographer, meteorologist, cartographer, hydrographer and biologist. It has not yet been decided whether wireless telegraphy will be included in the equipment.

The Nobel Literature Prize for 1913 has been awarded to the Indian poet, Rabindranath Tagore. Besides composing Bengali poetry, and his own translations of the same into English, he is a dramatist, historian, philosopher, and musician. One of his plays, "The Postoffice," was produced at the Court Theater, in London, last summer.

The Laws of Porto Rico are now available, in a bulky volume of 1,682 pages, just issued by the Bureau of Insular Affairs of the War Department. This notable work includes a compilation of the revised statutes and codes of Porto Rico, the acts of the Legislative Assembly (i. e., those of a permanent and general character) down to March 9, 1911, together with acts of Congress relating to Porto Rico and the treaty of peace with Spain.

Pictures by Cable.—According to a press report, Prof. Korn, who is well known to our readers as the inventor of the phototelegraph system reports that his invention has been so far perfected that he will be able to transmit messages across the ocean next year. He is planning to send pictures from Europe to New York and from New York to San Francisco at the opening of the Panama-Pacific Exposition.

Prof. Ferdinand Blumentritt, who died at Leitmeritz, Austria, September 20th, 1913, was probably the highest authority of his time on the Philippine Islands. He was so regarded by the Filipinos themselves, and his death is deplored by them as a national calamity; yet, strange to say, his knowledge of the islands was obtained entirely at second-hand, as he never set foot outside of Austria A monument is to be erected to him in the Philippines.

A Woman Explorer of Arabia.—A Russian woman, Countess Molitor, has just started on an attempt to cross Arabia at its widest part, from west to east, penetrating the desert of Roba'a-el-Khali. This huge desert is absolutely blank on the maps, has never been entered by a European, and is practically unknown even to the natives of adjoining parts of Arabia. The countess proposes to dress as an Arab and to be accompanied only by natives.

Centesimal Division of the Circle.—Most textbooks on trigonometry mention the suggested division of the right angle, or quadrant of a circle, into 100 parts, called "grades," each of which is divided into 100 centesimal minutes, and each of the latter into 100 centesimal seconds. According to the London *Times*, a bill will shortly be introduced in the French Chamber of Deputies to give legality to this substitute for the familiar sexagesimal system.

Sannikof Land, marked with an interrogation point on most North Polar maps, and supposed to lie due north of Kotelnoi Island, in the New Siberia group, was the principal objective point of Baron Toll's expedition in the "Zarya," 1900–1902, which cost the explorer his life. This land has been sighted by several explorers, since it was first seen, at a distance, by Sannikof, in 1811 According to *Petermanns Mitteilungen*, the rediscovery of this island was one of the fruits of Capt. Wilkitsky's (Vilkitskii's) remarkable expedition last summer, the capital achievement of which was the discovery of Nicholas II. Land.

Missing Arctic Expeditions.—Two arctic expeditions which sailed from Russia in the summer of 1912 have now not been heard from for so long a time that grave fears are felt for their safety. One, under Capt. Rusanov, after visiting Spitsbergen for the purpose of taking possession of some coal-fields on Bell Sound, attempted to proceed to Nova Zembla, but never reached there, so far as can be ascertained. The other, a large and well-equipped expedition under Lieut. Brussilov, sailed for the Kara Sea, intending to attempt the Northeast Passage to the Pacific, and to make extensive explorations all along the route. Provisions were carried for three years. Wreckage of a ship reported to have come ashore near the mouth of the Pechora River may indicate the fate of one or the other of these expeditions, and a steamer has been sent from Archangel to investigate.

Astronomy

Proper Motion and Distance of the Pleiades.—From a great number of observations it results that all the local groups of stars for which we have the necessary data are found to move in space very nearly parallel to the Milky Way. In each of these groups the parallelism of the movement is such that the parallaxes were determined. For the great majority of the stars they are easily comparable. Thus, for the stars, we know at the same time the position in space and the magnitude direction of linear movement. In investigating the mass of stars known as the Pleiades, they can be clearly divided into two groups, and in each of them the stars are sensibly more feeble than the normal magnitudes in corresponding groups. The question arises is there dispersion of light in a nebulous atmosphere surrounding the mass of stars? The question is at present very obscure.

High Potential Produced by Radium.—A radioactive substance which emits β radiations should, if isolated, acquire an increasing positive charge until a potential of the order of a million volts is obtained To verify this Mr. Moseley placed a small vessel containing radium emanation on a piece of quartz in the center of a flask which was highly exhausted A disk suspended from the neck of the flask by a quartz fiber formed a simple electrometer. It was found that a vessel of 9 millimeters in diameter attained a potential of 160,000 volts in a few minutes. A sudden discharge then took place across the residual gas in the flask. A vessel of 5 centimeters diameter becomes charged much more slowly, there is no discharge, and the final potential, 110,000 volts, is limited by a loss of electricity along the quartz support.

The Emptiness of Space.—When we speak of outer space, the space between star and star, as being empty of matter, it is rather interesting to see exactly what we mean We know from observations on the planets that light, in its passage across space to our earth, suffers hardly any absorption, and from this fact we can deduce conclusions respecting the density of such matter as exists in outer space. If the degree of rarefaction in outer space is, for example, in the neighborhood of the one hundred millionth part of an atmosphere, then the appearance of Jupiter, for instance, would be as if our atmosphere had twice its present opacity. So that such matter as exists must be in a much more rarefied state. But after all these terms are only comparative Suppose our atmosphere were allowed to expand up to the limits of the visible universe, as far as the Milky Way, then its rarefaction would be such that it would be quite impossible, by any optical means, to detect the presence of any matter. Nevertheless, there would be about five thousand molecules per cubic centimeter throughout space.

The Existence of the Ether.—The notion of a universal medium, permeating all space, has undergone many vicissitudes The sphere of celestial fire of the Alexandrians and the interstellar whirlpools of Descartes, gave way to the solid theory which was elaborated with immense skill by Young, Fresnel, Stokes and Kelvin, only to give way to the electromagnetic ether of Maxwell. At the present time there are at least three theories: one considers the ether as an incompressible medium, very rigid and very dense; another considers it composed of particles much smaller than electrons, and the third denies its existence altogether and seeks to eradicate it from the list of physical theories. It is this last theory which gains more and more adherants day by day We are in a revolutionary epoch, where the tendency is toward explaining phenomena in terms of emission rather than undulation, and of particles rather than fluids. And once more we see reappearing the mysterious and rather terrifying notion of the absolute "nothingness" of outer space which one imagined to be successfully abolished by the introduction of the ether.

Is the Sun Losing Mass?—The work of Einstein on the Principle of Relativity shows that a body which radiates energy loses a portion of its mass depending on the energy radiated. It follows that the sun, which continually radiates energy, is constantly losing mass. M. J. Bosler has calculated that the sun loses a mass equal to that of our earth in thirty million years. If it be assumed that the mass thus lost is gravitational mass it follows that the length of the year increases by six seconds in a million years, and that in the same time the mean longitude of the earth is affected in such a way as to produce a variation of one tenth of a year, i e., a retardation of thirty-six days in the seasons. Such variations are too minute to be observable. In stellar systems possessing a higher temperature the effect would be much more marked, for the energy radiated by a body varies as the fourth power of its absolute temperature If, as M. Nordmann believes, there exist stars having a temperature six or seven times that of our sun their radiation is one or two thousand times as intense. Thus, if the temperature of Algol is 13,800 degrees (Nordmann) it is calculated that at the end of two thousand years the eclipses of Algol suffer a retardation of about twelve minutes.

The New Curtiss Monoplane Flying Boat

IN the monoplane flying boat designed by Glenn H. Curtiss for Raymond V Morris of New Haven, features will be found that will be both approved and disapproved

In form the hydroplane hull suggests an expensive imported cigar; big at the end between your teeth, flat part of the way on one side, and tapering gently to nothing at the other end. Its principal dimensions are: length 22 feet; beam, 30 inches; depth, 36 inches. The bottom, as far back as the step, is the new double V type found in the new navy boats "C-3," "C-4," "C-5." The bow is pointed instead of square. Two holes in the hull permit the entrance of the pilot and, possibly, of one passenger. The pilot's seat is low, both to give him every protection from the wind, and to bring the shoulder yoke at the greatest diameter of the hull Unless the pilot sits up very straight only half of his head shows above the coaming

The wings are set about 40 inches above the hull, attached at the top to the welded steel structure supporting the engine bed, and braced below by struts extending to a cross beam which carries the balancing pontoons

The design of the wings is not unlike that of the European Etrich machine, and suggests a bird's wings The idea of placing the engine above the wings has been carried out before, notably in the Santos-Dumont machines. The position of the pilot, with such a weight above his head, is obviously dangerous. The total spread of the wings, from tip to tip of ailerons, is 34 feet. The spread of the supporting surface is 28 feet For 20 feet in the center the chord is 60 inches, while for four feet at each end the main surface is practically triangular.

Rudder, flippers, and rear stabilizing surfaces follow the lines of those used in standard models of the Curtiss flying boats, modified as to size to fit this smaller machine.

The machine was successfully tried out early in January.

The new Curtiss monoplane flying boat.

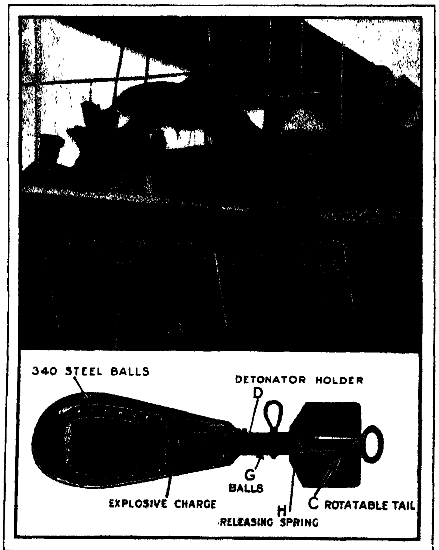
An Aeroplane Bomb That Explodes Only on Striking the Ground

THE new Marten-Hale aeroplane bomb, recently tested in England, has a very simple priming mechanism so that it can be carried in a magazine on board an aeroplane without danger of accidental explosion Should a bomb be hit while the aeroplane is in flight, or in case the aeroplane descended violently to the ground, by accident or otherwise, it is impossible for an explosion to take place. The bomb can explode only upon making a certain fall through the air and then striking the ground or other obstacle

At the top the bomb has a tail piece *C* rotatable by the air vanes The detonator holder *D* is held up away from the main charge by means of its collar and ball-bearing *G* held in place by the projecting end of a screw releasing spindle *H* When the bomb drops and the spindle rotates through the action of the vanes, it is screwed up until the projection moves away from the steel balls and allows them to fall inward, thus releasing the collar and the detonator. But the detonator still remains off the charge through the spring. When the bomb hits the ground, the detonator falls down on the charge and fires it, exploding the bomb in the customary way Such bombs can be dropped simply by hand from the aeroplane or can be fired by a spring gun in case a greater velocity is required

We illustrate a bomb of the shrapnel type, which has a total weight of 20 pounds and carries an explosive charge of about four pounds of trinitrotoluol. It has 340 steel balls, which weigh 5 pounds 12 ounces

A drop through at least 200 feet in the air is needed in order to cause the rotation of the tail end sufficient to give the release and arm the bomb as we have just seen, and as the firing mechanism is very sensitive, it gives an explosion upon the least impact even on water, mud, snow or the envelope of an airship. The angle of incidence can be as low as five degrees, as it is found. It is found that when dropped in any position from the aeroplane or at any speed of flight, the projectile soon takes the vertical position in falling, so as to hit the ground quite straight and end-on, and there is no tendency to somersaulting or wabbling in the air, which has been a source of trouble in other cases.



An aeroplane bomb that explodes only when it hits the ground.

Curing Noise in a Concrete Building

By E. P. Dorman

WITH buildings of concrete construction used for office purposes noise is often a very annoying feature, more especially so on floors devoted to general offices where large unbroken rooms occur, often sparsely furnished, and having relatively a few people working in them compared with the size of the room.

Under such conditions the sounds produced by people walking about, or shuffling their feet on the concrete floor, by typewriters, or even from talking, are greatly enhanced and echo very badly.

In a four-story building of reinforced concrete construction throughout, erected recently by an industrial corporation, for use exclusively as an administration building, the noise, particularly on one of the floors, was the greatest nuisance, it being at times well nigh an impossibility to hear what anyone said when talking over the telephone, and various expedients were tried during several months in an effort to remedy the trouble, without success. The main room on this floor is flanked on two sides by private offices used by the management, which were separated from the main office by partitions of wood and glass, carried up about eight feet from the floor

Notices were posted prohibiting whistling, loud talking, slamming doors, etc., which of course reduced the noise from these causes, but still left a good deal that was unavoidable. In another attempt to keep the noise out of the private offices, the partitions were carried clear to the ceiling, which is about 10 feet 6 inches from the floor. This form of partition, however, is by no means soundproof, and concrete floors and ceilings will transmit sound in spite of partitions.

Finally, after various other experiments had been tried, a professor from one of the leading universities, who is an authority on acoustics, was consulted. He advised putting down a square of carpet or a rug in the center of each of the private offices, and one or two in various spots in the main office.

His advice was followed, but in much the same frame of mind that must have been Cinderella's when, after listening to a glowing description of her coach and six horses, she was told to look for a pumpkin and six white mice.

The result in each case was a great surprise, however. The echo from the voice in talking has entirely disappeared, the office force no longer seems to be perpetually shuffling its feet at the desks, and the clicking from eight or ten typewriters, although they are situated on an uncarpeted part of the floor, is markedly subdued. The general sense of quiet is most noticeable, and this in an office through which there is constant passing from one department to another, to be added to the countless other noises that go to make up the general hum of an office.

It would seem that here lies one simple solution of the noise problem that is often advanced as one of the drawbacks to concrete construction for office buildings.

The German Observatory in Spitzbergen

AN account of the recent activities of the Spitzbergen institution, which was called into being by the Zeppelin-Hergesell expedition to Spitzbergen to study conditions with a view to an ultimate airship journey to the pole, is given by its director, Dr. Kurt Wegener, in *Petermanns Mitteilungen*. The observatory is located at Cross Bay, where the little staff of four men have erected their own buildings, viz., a two-story dwelling-house, a small balloon-house, a store-shed, and a rotating pavilion for the kite-winch. Besides the base station, there is a thermometer shelter at the top of the De la Brise Mountain (altitude, 2,000 feet), 4 miles distant, where temperature observations are made throughout the winter. The periodical ascents of this mountain afford an opportunity of observing the state of the sea-ice. An automatic tide-gage and a seismograph are kept in operation. Between June, 1912, and September, 1913, pilot balloons were sent up 270 times to determine the speed and direction of the upper air currents; the maximum altitude attained was over 8½ miles. Observations of temperature and humidity were obtained from 115 ascents of kites and captive balloons, up to a height of nearly 3½ miles. The observatory has a small outfit for wireless telegraphy, which exchanges messages with the powerful wireless station in southern Spitzbergen (this, in turn, being in regular communication with European stations). On one occasion the time signals sent out from the Eiffel Tower, 2,175 miles away, were received directly at the observatory, the longitude of which was thus determined with an accuracy unprecedented in the history of scientific stations in the Arctic regions. Lastly, some remarkable photogrammetric measurements of the altitude and distance of auroras have been made according to Störmer's method. The director of the observatory, with three men from the marble quarries at King's Bay, made a long sledge-journey into the interior in January, 1913, in a gallant effort to carry aid to the unfortunate Schröder-Stranz expedition.

Tokens of Changing China are seen in the immense increase of certain classes of imports into that country. In twelve years the annual consumption of kerosene has increased from 83,579,724 to 197,902,362 gallons, while the importation of lamps and lamp ware has trebled. During the same period machinery imports have increased from $1,000,000 to $3,000,000, with an additional item of nearly $1,000,000 for sewing machines. Matches and match making materials show an increase of over 300 per cent. Imports of clothing, hats, boots and shoes have increased tenfold.

Watching the World Revolve

IT was in 1851 that Léon Foucault ocularly demonstrated that the earth rotates. The occasion was one of historical interest. Foucault sent out invitations which were worded:

"You are invited to witness the earth revolve in the southern hall of the Paris Observatory, to-morrow, at half past two."

Since that invitation was extended, the experiment has been repeated many times. It has been described in the SCIENTIFIC AMERICAN whenever it was performed on a scale at all commensurate with that inaugurated by Foucault himself. Thus, some years ago, Prof. Forbes of Columbia University showed how the earth revolved in St. Paul's Chapel of Columbia University. On that occasion Prof. Forbes himself wrote an article for the SCIENTIFIC AMERICAN, in which the manner of conducting the experiment was described and illustrated.

Recently Prof. H. H. Turner of Oxford University repeated the experiment during the course of some juvenile lectures which he delivered at the Royal Institution. The Royal Institution is so important an organisation, and Prof. H. H. Turner so well known an astronomer, that naturally his lecture attracted not a little attention in the public press. Since the subject has thus once more been brought to attention it may not be amiss to set forth the principles of the experiment again.

Foucault suggested that a pendulum so suspended as to be free to swing in any vertical plane would ocularly demonstrate the earth's rotation. That this is so any reader can easily prove for himself. He has only to hold between the thumb and forefinger of one hand a thin cord to the bottom of which a fairly heavy weight is attached. As the weight swings the arm may be moved almost in any direction, without appreciably changing the plane of the pendulum's beat.

In the accompanying diagram let us suppose that *AB* is a straight horizontal rod from which the free pendulum *CD* is suspended in the manner indicated at *C*. Suppose the pendulum to be set swinging in the direction of the length of the rod *AB*, so that *D* remains throughout the oscillation vertically under the rod *AB*. If the rod *AB* be horizontally rotated in the manner indicated by the arrows, it will be found that the pendulum does not follow the rod, but continues to swing in the same plane as before.

It does not matter if the point *B* of the rod is fixed, and if the rod itself is shifted by moving the end *A* horizontally around *B* as a pivot. The pendulum still continues to swing in the same plane. This is true whatever may be the length of the rod. Hence it is clear that the same fixity of the plane of swing will be observed if the rod be shifted horizontally as though forming part of a radial line from a point *E* in its length. In these cases the plane of the pendulum's swing will indeed be shifted bodily, but the direction of swing will still continue in the same plane.

Let POP' represent the polar axis of the earth; *ab* a horizontal rod at the pole bearing a pendulum as shown. If the earth is rotating about POP' in the direction shown by the arrow, the rod *ab* is being shifted round precisely as in the case previously considered. The swinging pendulum below it will not partake in its motion, and thus, through whatever arc the earth rotates, from west to east, the plane of swing of the pendulum will appear to travel from east to west under *ab*.

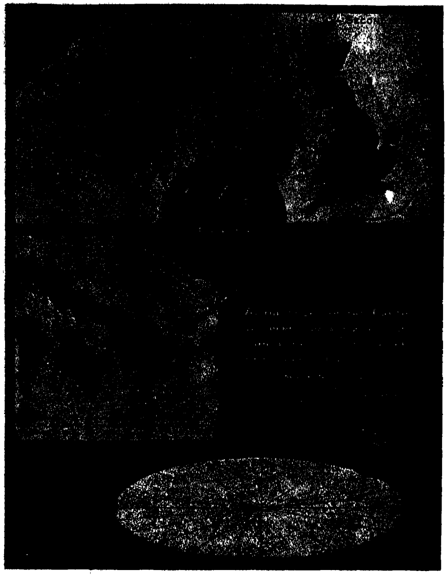
A pendulum, however, cannot easily be set up at the pole of the earth. The experiment must be conducted at a more convenient point. Suppose *AB* to be a pendulum-bearing rod, placed (for convenience of description merely) in a north and south position. Then it is clear that *AB* produced meets the polar axis produced (at *E*) and when, owing to the earth's rotation, the rod has been carried to the position $A'B'$, it still passes through the point *E*. Hence it has shifted through the angle AEA', a motion which corresponds to the case of the motion of *AB* (diagram) about the point *E*, and the plane of the pendulum's swing will therefore show a displacement equal to the angle AEA'. It will be seen at once that for a given arc of rotation the displacement is smaller in this case than in the former, since the angle AEA' is obviously less than the angle AKA'. In the latitude of New York a free pendulum would seem to shift through one degree in about five minutes.

It is obvious that a great deal depends on the mode of suspension. In Foucault's original mode of suspension, the upper end of the wire bearing the pendulum was fastened to a metal plate by means of a screw. It might be supposed that the torsion of the wire would appreciably affect the results. In reality, however, the torsion was very small.

It is usually customary to fasten a stylus to the bottom of the bob, which stylus, as the bob swings, plows through a layer of sand on a horizontal table. Spectators find it hard to believe that the pendulum is not swinging round toward the east, but that it is the table itself that is slowly and imperceptibly turning in the opposite direction.

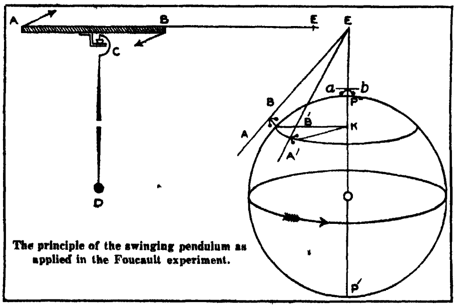
When Foucault made the experiment, he availed himself of the favorable physical conditions of the Pantheon in Paris. His pendulum weighed 62 pounds and was 210 feet long. It is necessary to use a massive sphere. The suspending wire is made as long as possible in order to get considerable linear with small angular displacement. Besides this, when the pendulum is long it swings slowly. This facilitates the readings.

The experiment is most easily understood if it is supposed to take place at one of the earth's poles, say the north pole. Here to an observer the earth would revolve horizontally from west to east. If at the pole the pendulum is set to vibrating in any direction with regard to space, a line drawn on the earth under the ball will rotate around the pole counter-clockwise, and complete its rotation under the plane of the swinging pendulum in 24 hours less 4 minutes (the sidereal day). The movement would therefore be about 15 degrees per hour. The desirability of position for the performance of the experiment diminishes as the equator is approached, at which place it is inoperative. The rule for determining the time of the complete rotation of the ground line is this: Divide 23 hours and 56 minutes by the sine of the angle of latitude where the experiment is being performed. For the latitude of New York city the time would be 36¾ hours. To get the distance the line moves per hour, divide 360 deg. by the time of the rotation of the ground line. For New York city it would be 9.8 deg.

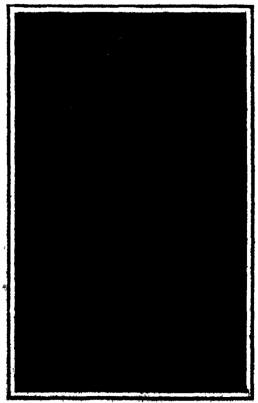


By courtesy of the *Illustrated London News*.

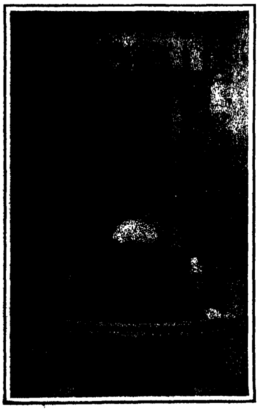
The famous experiment of Foucault.



The principle of the swinging pendulum as applied in the Foucault experiment.



The pendulum is usually started by burning the thread. The pendulum is brought to rest by gravity and resistance of air.



In repeating the Foucault experiment Prof. Forbes used an electrical device to keep the pendulum vibrating for any time.

◆

The Only Lacrosse Stick Factory in the World is located at Cornwall, Ontario, according to a consular report from that place. The game originated in that region, and the Indians thereabout have special skill in whittling the handles of the sticks. The factory employs ten Indians, most of whom will work only in winter. Three fourths of the product is consumed in Canada, the rest going to the United Kingdom, Australia, and New Zealand, except about one per cent which is sent to the United States—principally to the Carlisle Indian School and Ithaca, N. Y. About $2,000 worth of hickory wood for the sticks is annually imported from the United States, while the gut comes from England.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

What Machine Has Displaced the Greatest Number of Men?

To the Editor of the SCIENTIFIC AMERICAN:

We would like to have the name, or some slight information, regarding the machine or machines which has displaced the greatest number of men, and where we would be most likely to see one.

We have been told that it is a shoe machine, but as we want to know for business purposes, must have authentic knowledge, and we know your word is final.

Your favor in this matter will be greatly appreciated.

Philadelphia, Pa. J. J. GEISINGER COMPANY.

[The question here raised is most interesting. Perhaps our readers will let us have their views.—EDITOR.]

The First Wireless Time Service

To the Editor of the SCIENTIFIC AMERICAN:

In my article on the wireless time service of Beloit College, which was published in the issue of January 24th, the claim was made that it was the first of its kind in this country. Since writing that article it has come to my notice that the United States Navy has been operating such a service since 1905 and should, therefore, be given full credit for being the pioneer in the field, not alone in this country, but in the world. It is all the more a pleasure to acknowledge the priority of the Navy because in that early day radio telegraphic appliances were by no means so well developed as at present. E. A. FATH.

Beloit, Wis.

How to Fly Across the Atlantic

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN of December 27th, 1913, Mr. Henry Harrison Suplee gives his ideas of "How the Atlantic could be most easily crossed in an aeroplane." Others in Europe have suggested different routes, but never have I seen suggested the route I am going to mention, and that seems to me the most practicable because of the short stages of the trip and of the weather conditions.

	Kilometers
Tarfaya, west coast of Africa, to Lanzarote Island (Canary route)	150
Lanzarote to Funchal (Madeira)	470
Funchal to San Miguel (Azores)	800
San Miguel to Fayal (Azores)	290
Fayal to Santa Cruz (Azores)	260
Santa Cruz to St. John (Newfoundland)	1,800
	3,770

The distances are approximate.

The longest distance, 1,800 kilometers, could be divided in two stages by having a station ship located midway.

Aeroplanes will easily speed at 60 miles an hour (98 kilometers), then the longest stage (900 kilometers) would be covered in nine and one half hours. This has been made before.

By making several stops at the Canaries, Madeira and Azores islands, the stages could still be reduced in length.

Mr. Harrison Suplee's suggestion of a northern route would freeze any aviator traveling at the rate of 60 miles an hour. J. ARMENDAIZ.

Alpine, Tex.

[Our correspondent forgets that the Atlantic would be crossed at a height well above 2,000 feet, and that at great altitudes there is little difference in temperature between the frigid and torrid zones of the earth.—EDITOR.]

The Zuider Zee and the East River

To the Editor of the SCIENTIFIC AMERICAN:

Mr Hiehl's article on the partial draining of the Zuider Zee in your issue of January 24th, naturally appealed to me with unusual interest, seeing that it was after reading an account of this same gigantic project in *McClure's Magazine* of October, 1903, by Mr Walter Wellman, that the idea occurred to me of filling in the East River by the application of the same method of engineering as that proposed in Holland, my proposal being contained in a letter which appeared in the SCIENTIFIC AMERICAN SUPPLEMENT of July 9th, 1904. Quite recently I have seen it stated that a plan to obliterate the East River was first made some fifty or sixty years ago, but up to the present I must confess to being unable to verify this very broad and indefinite assertion. Perhaps, however, some reader of your paper may be in a position to throw light upon the point in question, and to say who originated the plan, besides giving the actual date and means to be employed.

It certainly argues much for the forethought, resolution, and enterprise of the Dutch character that a work of such unparalleled dimensions and difficulties as the reclamation of the Zuider Zee should have been at length decided on by the States General. Whether in like manner the project of turning the East River into dry land will be adopted is a problem that perhaps will be reserved for a future generation of Americans. At any rate, it has found much favor during the last ten years with several noted engineers, as repeated articles in the New York press during that time bear testimony.

New York city. N. W. STILL.

Arrangement of Magneto Magnets

To the Editor of the SCIENTIFIC AMERICAN:

In reading the account of your associate editor's trip through the Ford Motor Company's factory, in the SCIENTIFIC AMERICAN of January 8th, on page 9, column 3, lines 8, 9, and 10, I note the following error in stating the method of placing the magnets in trays:

"With the north pole of one magnet touching the south pole of the next adjacent magnet, and so on."

This should read, "with the north pole of one magnet touching the north pole of next adjacent magnet, and south pole of same magnet touching south pole of next adjacent magnet, and so on." The magnets should be placed in tray so as to have no attraction for each other. Thus the two north poles constitute a positive pole in the magneto, and the two south poles constitute a negative pole, hence their alternating current.

I think this should be corrected in your columns, as it will mislead those not familiar with magnetism, and those who might be saving that part as instruction in replacing the magnets on their Ford cars.

ROBERT L. WHITCOMB.

Memphis, Tenn. Supt. Memphis Assembling Plant.

The "Nevada" and the "Queen Elizabeth"

To the Editor of the SCIENTIFIC AMERICAN:

I have been much interested in the recent discussion as to the offensive and defensive qualities of the 25-knot dreadnoughts of the "Queen Elizabeth" type and our "Nevada" type. The information given us in the SCIENTIFIC AMERICAN is not sufficient to enable one to determine which of the two types will prove the more effective all-around ships. I believe, however, if it were possible to obtain the full details showing displacement, fuel carrying capacity, kind of fuel, speed, radius of action, armor protection, torpedo defenses, etc., that the differences in favor of either ship would be immaterial.

To my mind, the prime requisite quality of a fighting ship of to-day is the ability to concentrate an irresistible attack. You have told us that the result of target practice in the British and American fleets was about the same, namely, forty per cent, until the fire control system was installed in the British ships, increasing their efficiency more than 50 per cent. This, to my mind, is where the British ship is superior to ours. You have told us that, in view of the increased efficiency by reason of this fire control system in the British ship, theoretically one round from said ship would either sink our "Pennsylvania" or so cripple her that she would have to retire from the scene of action. Consequently, there is only one conclusion I can come to: regardless of the fact that the "Nevada" could train two more guns than the British ship, she would be subjected to a preponderance of force that would be irresistible.

I would be much interested to learn more definitely showing a superiority in some way or another in our "Nevada" type sufficient to compensate us for the extra speed and the superior means of concentrating an attack in the British ship. R. DANIELS, JR.

New York city.

[By "fire control system" our correspondent, we think, must have in mind Admiral Scott's "director system," by which the target practice of the British fleet was improved over 100 per cent.—EDITOR.]

The Relation of the Ant, Leaf Roller and Spider With Bark Diseases

To the Editor of the SCIENTIFIC AMERICAN:

So many things have been attributed to the chestnut and other bark diseases that most people are apt to regard anything new respecting them as of little consequence. My experience, however, may throw a new light on this subject. It is a well known fact that the ant, aphide and the spider live together; this has been established by entomologists. Of the leaf roller, however, little seems to be known. Does the ant take care of this insect also, and what is his part in the disease?

I have found by carefully examining this insect and watching his development during the past summer, that the leaf roller is really the enemy of the tree. The way this is produced is very interesting. First, the spider and the ant take the leaf roller up the tree—in what numbers I do not know. But here the leaf roller begins his work, always guarded by the spider, and, strange as it may seem, this leaf roller lives entirely on the spider's web. This is done early in spring. The leaf roller makes a house for the aphide in the curled leaf of the chestnut which follows the ant, and is the first to appear in early spring; then come the others. I carefully put this leaf roller away in spring to develop. However, there was no development, and I was at sea to know what he was until one day in October I was looking for new evidence when I came across several of these leaf rollers. I tried to develop them again, and, to my surprise, I found out that the bottle I put these leaf rollers in was alive with small sucking insects which came from the leaf roller's body. Having discovered this, I compared them with the insects taken from the swelling of the tree and they proved to be the same in every case. These insects girdle the tree and go under the bark a distance of one and a half inches so that no spray will ever touch them or destroy them, and there is no hope for the tree unless these insects are kept from going up in spring. Once affected the tree is sure to die. That the ant is at the bottom of all this there seems to be no question. It is said that a live culture of this disease has been made. I think that this would be possible as the insects are like so much dust. We have F. R. Meyer's report that he has found this disease in China. If this is true, why does it not kill trees in China? Then come reports from India that the ants are killing the trees out there. If this is true, then why can the ant not kill trees in the United States of America? ARTHUR LAVIN.

Bernardsville, N. J.

Bacterial Versus Inorganic Fertilizers

To the Editor of the SCIENTIFIC AMERICAN:

I read in your issue of January 24th an interesting letter by R. W. Davis of Moline, Ill., about "Bacterial versus Inorganic Fertilizers for the Soil." Mr. Davis takes issue with Mr. Cahill's statement that the artificial fixation of atmospheric nitrogen is one of the ten greatest inventions, especially in its relation to agriculture. He claims that this discovery is not important to agriculture because nitrogen is so easily obtained from the atmosphere through certain bacteria found on the roots of leguminous plants.

Now we all know that leguminous plants are a very fruitful source of nitrogen, but it is a very slow and a very hazardous process of obtaining it. If a leguminous crop could be grown as easily as weeds and with as much certainty, it would be another question. But this is not the case. It requires not only that the soil shall be in good mechanical condition, but good seed, and especially freedom from thawing and freezing, which destroys leguminous crops, especially alfalfa and clover.

Peas, beans and vetch planted in an orchard may supply the necessary nitrogen because fruit trees, as a rule, do not require as much nitrogen, and because they are feeding a good share of the time. They are permanent in the soil, but this is not true of the great family of hoed crops like corn, potatoes, cabbages, and small grains which mature inside of 120 days, and which require the bulk of their plant food within 60 days of the growing period. They must have nitrogen then or never.

Abroad and in the eastern part of this country they do not depend upon leguminous plants to supply the nitrogen for the staple crops, and never will. It is true that commercial fertilizers do not supply any considerable amount of organic matter, but this can be kept up by applications of stable manure and by growing catch crops or cover crops which can be plowed in from time to time.

From Mr. Davis' point of view we would not be justified in even utilizing the by-product nitrogen of our industries, the by-product nitrogen obtained from tankages, seed meals and fish waste. Is it not well to conserve this nitrogen and apply it to the soil, much of which has come out of the soil in the shape of crops which have been fed to animals? Also the enormous amount which is obtained in the shape of sulphate of ammonia from the soft coals which are used for coking purposes? Right under a good share of Illinois, in which Mr. Davis lives, there is a vast amount of nitrogen stored up, which some day will be utilized. Again, is it not well to utilize the thousands of horse-power going to waste in our great waterfalls, in creating electric energy with which to extract the nitrogen from the air, which in turn may be applied to the soil of Illinois to restore the nitrogen which has been exported in cereals all along the line of conservation.

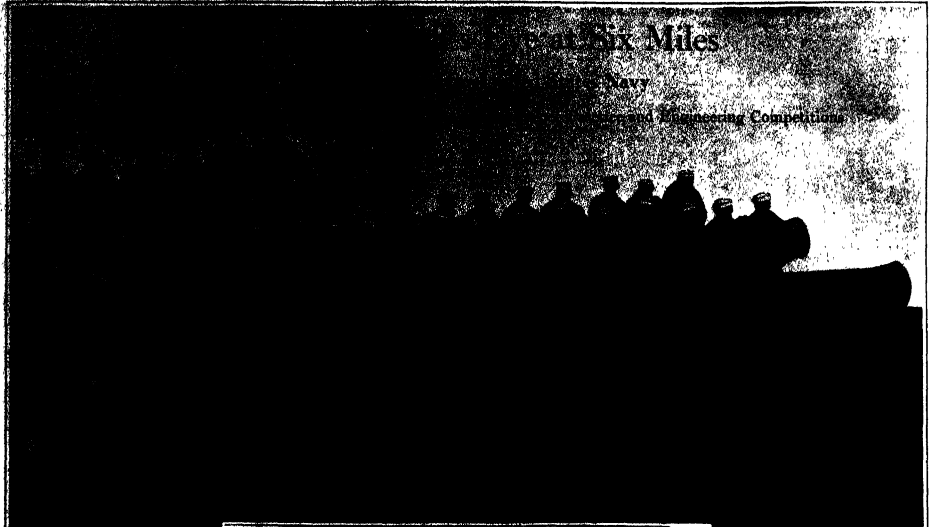
We are doing it now in the cyanamid of which you speak in your editorial comments, also in the nitrate of lime made in Norway; and it is confidently expected that we are going to do it by some catalytic process which may be either exothermic or endothermic. It is predicted that some day nitrogen will be as cheap as phosphorus and potash, but whether it is or not, the commercial farmer will not wait upon the slow and uncertain process of obtaining atmospheric nitrogen through leguminous crops; that is, if we may judge by the growth of the fertilizer industry, both in Europe and in this country in the past ten years.

Boston, Mass. W. H. BOWKER.

at Six Miles

Navy

and Engineering Competitions



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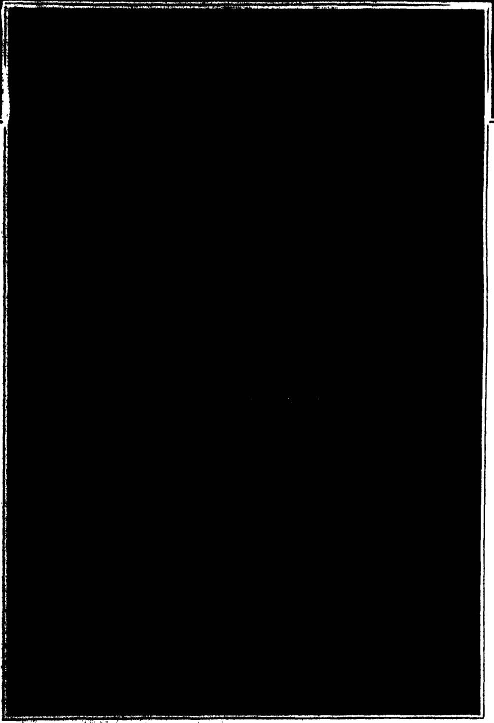
Crew of turret on "North Dakota" which won the E (excellent) badge.

SINCE the beginning of our history the United States has always led in the development and advance of gunnery; an exception being during that period which followed the Civil War, when our position changed from that of the leading naval power among the nations of the earth to that of one of the weakest. During that period of retrogression certain officers remained alive to the needs of the navy with respect to gunnery; but lack of appropriations and a flagging interest on the part of the country in naval matters, together with a deep-rooted conservatism on the part of individuals, stood in the way of progress.

A volume of considerable size was published in 1886 by the Navy Department on the "Target Practice of the Vessels on the North Atlantic Station," in which appears an effort to arouse the interest of the service in this matter. The volume lays down a course of training and "Rules for Fire." The principles given were essentially those of today. In the training recommended, "sub-caliber" was an important feature, a small arms rifle being attached to the larger piece and fired at a target at a reduced range. All sights were set together as ordered by the gunnery officer, and the guns were fired in succession or in salvo, the fire being controlled by an officer aloft.

But little real progress in promoting interest in gunnery was made for some years; a revival began, however, with the reconstruction of our navy; and while the marksmanship during the Spanish-American war did not compare with that of to-day, the gunnery of the few vessels then composing our battle fleet was probably not inferior to that of any navy of the world at that time.

The methods of training inaugurated by the well-known English officer, Admiral Sir Percy Scott, came to the notice of Capt. W. S. Sims, then a lieutenant of many years standing, about 1901. Sims put his shoulder to the wheel, and, supported directly by President Roosevelt, he overcame the departmental inertia and established for us a definite plan for gunnery work and training.



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"Idaho" repelling torpedo attack at night.

For years previous to this time target practice had been under the control of the Bureau of Ordnance, which was also charged with the design and supply of materials. An annual allowance of ammunition was authorized for target purposes, but no definite plans for practice were drawn up, and the ammunition for testing of materials and the training of crews was not always expended to the best advantage.

It is obvious that this system was defective and could not make for progress The office of the inspector of target practice was established in 1901 under the Bureau of Navigation, and it remained there until taken over by the Division of Operations of the Fleet.

In 1896 a shot every three minutes from a turret gun, and one a minute from a six-inch weapon were considered to be satisfactory performances A good "line shot," but "a little short" or "over," was very common and accepted as satisfactory comment at target practice. It has been calculated that we made about 3½ per cent of hits at the battle of Santiago at a range of about 3,000 yards Most of these were with the smaller guns How different the results of to-day, when more than three hits a minute are made from 12-inch guns, and eight are not infrequent from those of 6 inches in caliber. In the spring of 1911 the "San Marcos" was destroyed in a very short time by the guns of the "New Hampshire" firing at a range of about six miles The percentage of hits was a sufficient demonstration of improvement and of the progress up to that time.

In the beginning of our modern development, and for some time after the establishment of the Target Practice Office, target firing was held in smooth water, at measured ranges. These conditions obtained for several years. Defects in material were discovered and remedied, and officers and men were schooled in the elements and principles of gunnery.

In the practice of to-day realism is sought. Firing takes place under battle conditions, as closely as they may be simulated, and with regard for the casualties to be expected in battle. The elementary practice for the testing of gun's crews and pointers is held at a short range with a small target, just large enough to catch exactly aimed shots. This form of firing is primarily a competition between gun crews and pointers, and as a result of it the pointers are qualified.

When it is considered that a shell from a 12-inch gun, which leaves the piece with a velocity of 2,700 feet per second, at a battle range reaches a height of about a thousand feet, and strikes at an angle of approximately 9 degrees to the horizontal, it is not hard to understand the exactness with which the pointing and control must be accomplished in order to hit a moving target of small size. Loaded shells are not generally employed at target practice because of their expense. Cheaper projectiles of inferior metal, without bursting charges, are utilized for this purpose.

One of the numerous difficulties in obtaining skill in gunnery is that firing with smokeless powder causes erosion or a wearing away of the inner surface of the bore. This is most serious in the larger guns and necessitates the relining of these pieces from time to time, a procedure which costs about $10,000 and takes some months to complete. It has been found that the amount of this erosion, which like the muzzle velocity of the projectile, is a function of the weight of the powder used, and the consequent pressure, can be reduced by using smaller charges. For this reason reduced charges are generally employed at target practice in order to lengthen the life of the larger guns.

Having briefly outlined the recent development of gunnery and target practice, we will next take up the methods of training which are now employed and which have produced the results above described.

The members of the crew of United States naval vessels, as a class, are not equaled in intelligence by those of any other navy in the world. Young men are taken from every part of the country, provided they come up to the severe requirements for enlistment, and they are afforded the best of opportunities for advancement. A man with an honorable discharge from the Navy, if he sees fit to leave at the expiration of his term of service, has no trouble in obtaining a responsible position. A man who remains in the Navy, and attends to his duties, is sure of a promotion that compares very favorably with any that he may expect outside the service. Of course, he must put up with ship life and the restraints of discipline.

An important consideration in the promotion of efficiency has been the feature of competition. Gun crews on board ship are trained as carefully as any first-rate athletic team. Every detail and movement of the individual is carefully studied with the idea of eliminating interferences, and of producing team work which will develop a maximum of rapidity and accuracy of fire from each unit composing the battery.

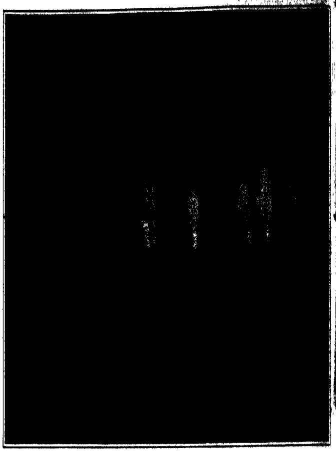
Loaders at other than turret guns are exercised at specially designed machines, where all the operations of loading may be performed without the excessive wearing of the mechanism that would be the case if actual guns were used for the purpose.

The gun pointers hold the positions of greatest importance. These men are selected because of their peculiar fitness for this work, which requires good eyesight, coolness, and nerve. In choosing candidates for the important duties of gun pointer, no qualities but these are taken into consideration. Pointers are carefully instructed in the manipulation of the piece and the duties of their station, and thoroughly drilled before their abilities are tested at elementary practice.

Pointers are divided into classes, and are given a gratuity each month in addition to their regular pay as shown in the following table:

Class	Duty	Additional monthly pay	
		1st class	2nd class
Heavy gun pointer	Pointers of guns of a caliber of 8-inch or above	$10	$6
Intermediate	Pointers of guns from 4 to 8-inch caliber, inclusive	8	4
Secondary	Pointers of 1 pounder to 3-inch caliber	4	2

The torpedo has steadily come to the front as a weapon. There are now torpedoes capable of running 11,000 yards at a speed of about 28 knots, and carrying over 200 pounds of high explosive. Torpedoes are carried on all classes of vessels, but are essentially the weapons of the destroyer, fast torpedo boat, and submarine. They are discharged from tubes either above or below the waterline. These projectiles are kept on straight, predetermined courses by means of gyroscopes. They are regulated in depth by means of a hydrostatic piston and pendulum, and are driven by engines operated by compressed air.



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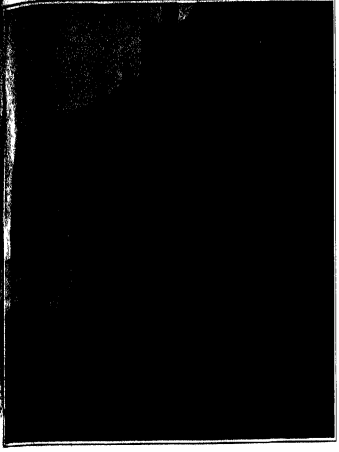
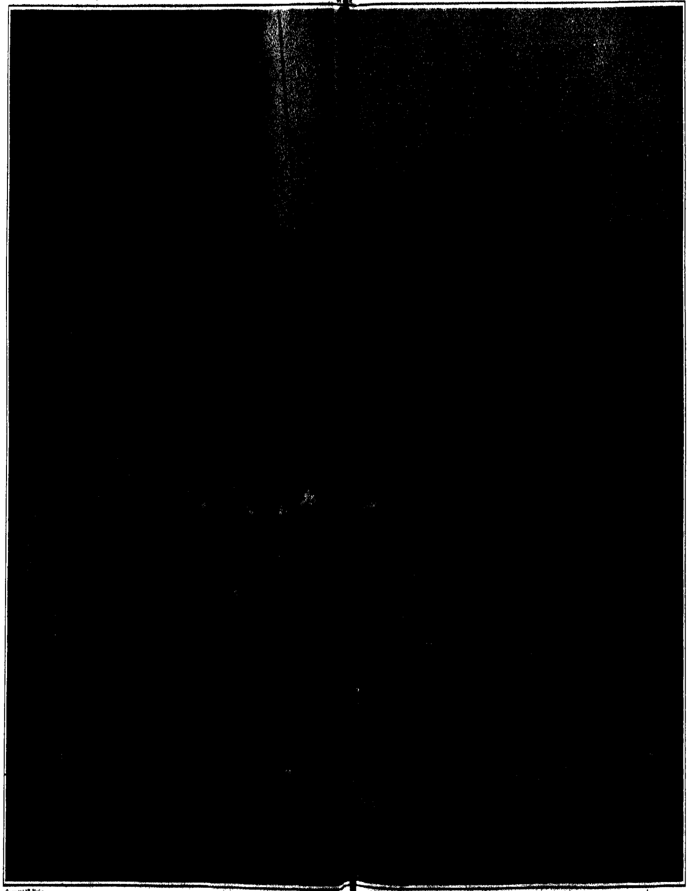
Splash of a six-gun salvo, as seen from the towing ship.



Good work by the gun pointers of the "South Carolina."



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First Division maneuvering, as seen [illegible] bridge of the "North Dakota."

The "war head" of a torpedo, containing the high explosive, and the nose for detonating the latter, are not used in exercise. This head is replaced by one filled with water which collapses on impact, without serious damage to the torpedo, and which may without injury be fired against the hull of a ship.

The torpedo men are usually given a special course of training and instruction at the torpedo school in Newport, where they are taught to care for the delicate mechanism of the torpedo and to make the adjustments necessary for successful running. Successful gun and torpedo crews are distinguished by a small block letter "E," which members thereof are authorized to wear on the sleeve for one year after the completion of the practice for which it has been awarded. Money prizes are also given to each man of gun and torpedo crews making the highest scores at target practice. A first prize amounts to $20, a second prize to $10, and a third prize to $5.

It is considered of importance that officers and men should have skill and knowledge of all the weapons which they may at any time be called upon to use, and special attention is given to the use of small arms in the Navy. When the record of an enlisted man shows him to be a sharpshooter or an expert with a small arm, he becomes marked at once as a trained man as well as probably one with nerve and sense of responsibility.

The large and well-equipped target range at Guantanamo, Cuba, is an excellent place for small arms work and for instruction and experience in landing operations. Each year vessels of the Atlantic fleet are required to land their men, and to conduct them through the small arms courses, and at the same time to exercise them in camping and in shore drills.

Cash prizes and medals are given for excellence with small arms and to the ship of the Atlantic, Pacific, and Asiatic fleets making the best performance for the year with these weapons is awarded the silver trophy for "small arms," which is held by that vessel for one year.

The combination of the scores of individual gun and torpedo crews at target practice is worked out, and the final standing of ships for the different practices are determined by the Department. At the end of the year the final combined scores for all forms of firing are determined for the different classes of vessels, and the trophies in gunnery are awarded.

These trophies are handsome bronze plaques on which are engraved the names of winning vessels. A trophy is carried by the leader of her class for one year. Letters of commendation are addressed to the officers deemed deserving of these at the close of the annual competition.

A competition is also conducted in engineering in the Navy, which has done much to produce economy in the expenditure of fuel, oils, etc., to promote efficiency, and to improve design.

Trophies similar to those awarded for gunnery are offered for excellence in this, and the members of the engineering department of the trophy winner are permitted to wear red "E's" on the sleeves of their uniforms similar to those authorized as a result of target practice to successful gun and torpedo crews.

Finally, the standings in the competition in engineering and in gunnery for each year are combined. Engineering is given a weight of 40 and gunnery of 60, and the multiples for what is termed "Battle Efficiency" are then determined for the different classes of vessels.

The leading vessel in "Battle Efficiency" of each of the different classes is awarded the right to fly the much prized pennant of red with a black ball for one year as a symbol of proficiency. It has been customary for the President to address a congratulatory letter to the captain of the battleship securing this prize, and for the Secretary of the Navy to similarly recognize the leading destroyer and submarine.

The above outlines the methods in vogue for the encouragement of competition between ships. The success of a vessel, in these competitions, is almost in every case directly measured by the spirit of the crew, and the pride and interest taken by them in the work of their ship, and this depends, almost entirely, on the attitude and intelligent zeal of the officers and the success with which they are able to co-ordinate and interest the men in accomplishing useful work.

The public accustomed to seeing the sailor about the streets of our seaports, seemingly idle when other men are busiest, does not always remember that this individual has been living with his work by night as well as by day for weeks and often months. Diversion and complete relaxation from his routine from time to time are necessary.

Because of the tremendous power and accuracy of modern ordnance, the effective use of their gun fire, on the part of one's opponents, in battle must be prevented. To accomplish this it is not only necessary to be able to hit at greater ranges than those at which an enemy is capable of hitting, but also to be able to make more hits than he under the difficult conditions imposed by a rough sea or bad weather, or with a rapidly changing range.

Eliminating the Flicker From the Moving Picture

A New System of Motion Picture Projection

By Joseph B. Baker

Motion picture projection rests upon the physiological phenomenon of "persistence of visual impression," whereby a momentary glimpse of a well-illuminated object prints an image on the retina which remains about one sixteenth of a second. In the ordinary motion picture method a rapidly succeeding series of snapshots are taken. These pictures are made one after another at the rate of sixteen per second upon a narrow strip of film, which is made to travel through the motion picture camera at the rate of one foot per second. There are therefore sixteen complete pictures in every foot of film. If the camera is pointed toward a scene in which is a falling weight, and the first picture shows the weight in the middle of the view, the second picture, taken one sixteenth of a second later, will show the weight in a new position slightly below, and the third will show a still further displacement of the weight, and so on. Say the weight has moved one foot between the instant of taking the first picture and the instant of taking the second picture. These two pictures will then show the beginning and the end of that one foot of movement, and there is nothing but a gap or blank in the interval between the pictures.

A thousand feet or more of this film may be taken of any moving scene. The projection on a screen to simulate the original scene is accomplished by making a positive transparency of the film negative and running the same through a specially contrived projection lantern, which throws an enlargement of the first picture upon the screen for an instant, then cuts off this image and one sixteenth of a second later throws the second picture on the screen, and so on. Before the impression of the first image has faded from the retina of the observer, the second image is impressed. The eye, retaining its impression of the falling weight as at one point in the general view and receiving an impression of the weight as at a new point, superposed upon the still lingering first impression, takes for granted the intermediate positions of the moving object. Thus it supplies, subjectively, the continuity of movement of the object—a continuity which is really quite lacking in the series of screen pictures. The action is just the same as viewing a field of running horses through a picket fence, as one travels along outside the fence. At a given instant the eyes have a clear view of the animated scene through a space between two pickets, the next instant the view is absolutely cut off by an interposing picket, then comes a new view through another space and another cut-off; but all the time the movements of the horses are seen apparently without a break. This system has its objectionable aspects. The film must move constantly so that it may not catch fire, and the "flicker" produced by the rapidly succeeding pictures produces eye strain. In the accompanying article an ingenious method is described, whereby it is sought to overcome these defects.—**Editor.**

THE ordinary motion picture apparatus demands a good deal of what might be termed continuity-preserving effort on the part of the human eye—just as catching spoken words reproduced by a phonograph or in a telephone receiver demands a good deal of the ear, in supplying with the imagination vocal sounds which are not fully reproduced by these instruments or not reproduced at all. (The field of mechanical devices is full of such partial accomplishments eked out by the accommodating human senses.) In the present system of motion picture projection, moreover, the rapidly recurring dark intervals between successive screen images and the eyestrain by variation of illumination (the so-called "flicker") have been objectionable to the observer. In the projecting machine, also, the intermittent movement of the film, the danger of fire from the heat to which the film is subjected during the instant it is held still for the projection of each picture, and the noise of operation, have been features that demanded radical improvement. A picture is projected for about 75 per cent of the picture interval of one sixteenth of a second; in the remaining 25 per cent of this interval the image is cut off by the blade of a revolving shutter, while the next picture is being brought into the focus of the lens; then No 2 picture is projected. Part of the time a single, fixed image is on the screen; the rest of the time the illumination is absolutely cut off. The eye, staring at the screen, must use its faculty of persistence of impression to help fill in, so to speak, the abrupt dark interval and then suddenly receive a new shock of full illumination. The eye is bombarded with a series of impressions very sharply and definitely spaced apart by periods of absence of illumination on the screen. As in watching a prestidigitator we enjoy imagining an actual flight of the mysterious coin from the operator's palm to the table-top thirty feet away, so the eye "plays up" in the enormously more rapid and continuously exacting game of bridging the gaps of the motion picture film.

But in enduring the flicker the eye pays heavily for its self-imposed delusion. The resulting eyestrain is a disadvantage which the public puts up with, and seeks to counteract by watching the screen at a distance of at least twenty feet back within a rather narrow sector.

The fire danger may be estimated from the intense light necessary to obtain a continuous visual effect of good illumination in the screen picture notwithstanding the very large ratio of enlargement (about 1 to 97,000) and notwithstanding the intermittency of the actual illumination. It may be said that the film is always just on the verge of igniting. Hence the strict fire laws governing motion picture exhibitions.

A new machine called the vanoscope overcomes these imperfections in an apparatus giving a continuous visual impression from a steadily moving film. Its "moving picture" is not made up of abruptly succeeding fixed images separated by dark intervals, but of images which genuinely dissolve into one another without any interruption of the full illumination upon the screen. While the apparatus will project any standard film, the successive pictures may be taken at very much longer intervals if desired, that is, fewer per second than the limit of sixteen per second required for the present system, and they may be reproduced at the same slow rate on the screen—a feature invaluable for educational and motion study work. In fact, the normal speed is 8 per second, which gives very great reduction in the length of film. It is possible to put a "1,000-foot play" on 800 feet of film. "Travel ghost" is eliminated. The pictures are projected without being abruptly cut off by a shutter, but by actually "dissolving," one image decreasing in intensity of illumination simultaneously with the increase in illumination of the next succeeding image. As at an ordinary lantern-slide exhibition, where a view of Fujiyama, for example, melts into a view of a crowded street in Nagasaki, the eye has only to relinquish the outlines of one picture and take up the outlines of the next, with comparatively little physiological effort.

To obtain this result a new mechanical movement of four mirrors, being the four right-angle segments of a circle, which deliver the film image to the projecting lens, is employed. Each segment of this four-part reflector has conveyed to it a movement such as would be given by rotating it on an imaginary axis and simultaneously rocking it for-

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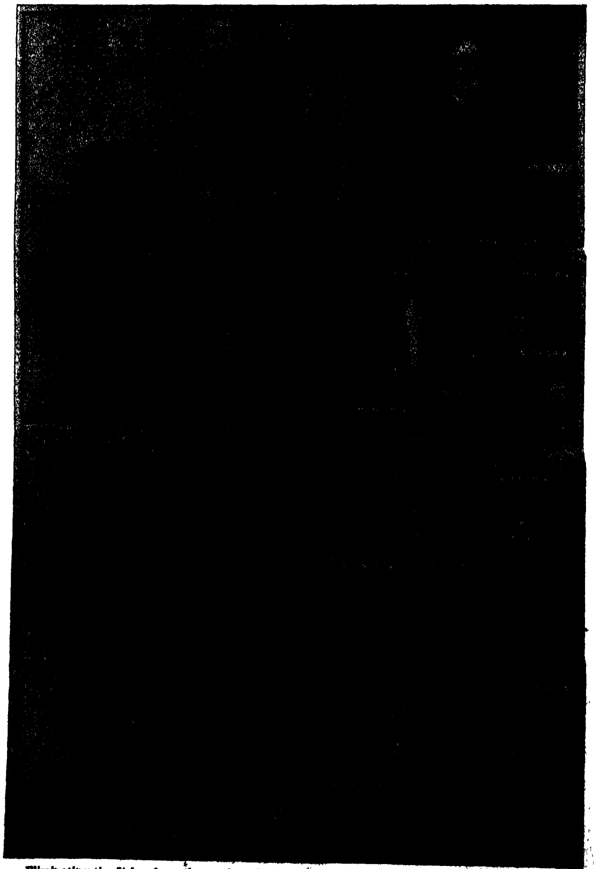

Eliminating the flicker from the moving picture. A series of pictures that show how it is done.

Where and How Radium is Obtained

The American Supply of the Most Precious Substance in the World

By John L. Cochrane

THE wonderful radium which is exciting so much comment these days because of its reported curative properties, especially in the instance of superficial cancer, is obtained from the minerals carnotite, pitchblende and also autunite. The popular belief has been, until recently, that the chief source of radium is the mineral pitchblende, especially that obtained from the mines now under the control of the Austrian government, at Joachimenthal, Bohemia. Outside of the ore in Austria, the only pitchblende deposits of any size are those in Gilpin County, Colorado, from which some thirty tons, more or less, have been procured since the mineral became valuable as a source of radium. The most important source of radium is the carnotite ore and the greatest known field of this ore is in the Paradox Valley of Colorado and Utah. There is a little carnotite in South Australia and in Russian Turkestan, but the supply of carnotite in the Paradox Valley is so great as to lead scientists to make the statement that the United States practically has a monopoly of the radium-bearing ores of the entire world. The autunite deposits of Portugal and South Australia are unimportant.

In order to aid prospectors in their search for radium-bearing ores and to enlighten persons all over the country who had a faint suspicion that their rear yards contained the precious substance, the National Bureau of Mines but recently issued the following:

"Radium is found with uranium minerals only. Wherever uranium exists, radium is also found in the mineral; and where there is no uranium, radium has never been found. Uranium and therefore radium are found in this country in carnotite and its associated minerals, and in pitchblende. Carnotite is a lemon-yellow mineral, usually found in pockets of sandstone deposits. The mineral may be in the form of light yellow specks disseminated through the sandstone, or as yellow incrustations in the cracks of the sandstone; or may be more or less massive, associated with blue, black, or brown vanadium ores.

"Pitchblende is a hard, blue-black ore that looks something like magnetite, but is heavier. It is found in pockets and veins in igneous rocks. This mineral is not nearly as widely distributed as carnotite. Occasionally it is found associated with an orange mineral called gummite."

Although, until recently, the manufacture of radium from carnotite has been carried on almost wholly in France and Germany, the American ores having been shipped in great quantities, there appears no good reason why our American carnotite should not be treated at home. Carnotite is much more easily treated than pitchblende and the essential features of methods for its chemical treatment are well known, although much of the mechanical detail of operation has been kept secret. As the mechanical requirements, however, are those which any well grounded chemical engineer should be able to solve, there seems to be no reason why any of our carnotite ores should be shipped abroad, even at two or three times the present market price of the material. As regards the principles involved, the methods have advanced little beyond the original method published by Debierne.

How Radium is Reduced.

The manufacture of radium from carnotite is a long, tedious, laborious chemical process, complicated in the extreme by the great difficulties encountered in separating the various foreign elements in the carnotite from the radium. The process has been likened to the method used in the purification of the table salt in every day use. The salt is placed in solution and the impurities driven off by crystallisation. This, however, is a child's work in comparison to the extraction of radium from carnotite. The carnotite is placed in solution, and step by step the various other elements are reduced in quantity through the process of crystallisation, each step leaving the radium freer from its associated impurities. The methods for extracting the radium from carnotite are best described by an eminent chemist in the following words:

"The most important operations in the working up of radium-containing materials are the solution of the materials, consisting usually of insoluble sulphates, and the separation of the halogen salts of the alkaline earth group in a pure state, followed by their fractional crystallisation. The first operation is usually effected by vigorous boiling with sodium carbonate solution, filtering and washing free from sulphate. This is the well known reaction studied dynamically by Guldberg and Waage, whereby an equilibrium is attained between the two pairs of soluble and insoluble sulphates and carbonates. Naturally the greater the excess of sodium carbonate the larger the proportion of insoluble sulphate converted into insoluble carbonate. In this operation it is advisable not to wash at once with water, but with sodium carbonate solution until most of the sulphates are removed, as thereby the reconversion of the carbonates back into insoluble sulphates is largely prevented. In dealing with crude materials—for example, the radium-containing residues from pitchblende—it is often advantageous to precede this operation by a similar one, using sodium hydrate solution containing a little carbonate, which dissolves part of the lead and silica present. The carbonates, washed free from sulphates, are treated with pure hydrochloric acid, which dissolves the alkaline earths, including radium. From the solution the latter may be precipitated as sulphates by sulphuric acid and reconverted back into carbonates as before, or sometimes more conveniently they may be precipitated directly as chlorides by saturating the solution with hydrogen chloride. This is a very elegant method of great utility in the laboratory, for the most probable impurities, chlorides of lead, iron, calcium, etc., remain in solution and only the barium and radium chloride are precipitated practically in the pure state, ready for fractionation."

Radium-bearing carnotite bags ready for shipment.

Nearly all American carnotite is sent to Europe for treatment. Now that we are beginning to evince some interest in our radium ores, perhaps we may soon treat carnotite ourselves.

From left to right—Dr. Karl Kithil, Dr. Richard B. Moore, chemists in the Bureau of Mines Laboratory at Denver, Colorado. Dr. Moore is in charge of the work of extracting radium from carnotite.

Miner showing carnotite in place, Paradox Valley, Colorado.

The manufacture of radium from carnotite is a long, tedious, laborious chemical process, complicated in the extreme by great difficulties in separating the radium from many foreign elements.

The National Bureau of Mines, at the suggestion of Dr. Joseph A. Holmes, established a laboratory at Denver, Col., two years ago for an investigation of the rare ores and immediately plunged into a method for the extraction of radium from the carnotite. Dr. Richard B. Moore and Karl Kithil, in charge of the laboratory, as the result of their work, declare that the simplest way to extract uranium, vanadium and radium from carnotite is to treat the ore or concentrate directly with boiling concentrated nitric or muriatic acid. Even the vanadium and silica combinations can be decomposed by boiling with these acids for an hour, nitric acid giving the better results. They found that carnotite itself is soluble in cold dilute hydrochloric or nitric acid. The practicability of such a process, they say, depends upon its cost and the possibility of readily recovering the radium.

At the time the Bureau of Mines began its labors in Denver, no radium was being manufactured in the United States. The carnotite ores were being shipped to Europe at an alarming rate and at a price in no measure commensurate with their value. The ores are still being shipped, but all of it is not going out of the country. At least two American concerns are making radium and one has already placed some on the market, but it is understood that the output of this concern, for some time to come, will go to Europe. That the extraction of radium is apparently a very profitable business is seen in the assertion of the chemists of the Bureau of Mines. Messrs. Moore and Kithil say that while the cost varies in different places, being governed by the cost of labor, chemicals, freight, etc., $20 per milligramme is probably a maximum cost in Europe for extracting radium from carnotite ores. When it is considered that radium is selling for $120 a milligramme the wide margin of profit can easily be seen.

An important development as a result of the investigations of the Bureau of Mines has been the establishment of the National Radium Institute, with Dr. Howard A. Kelly of Johns Hopkins Hospital, Baltimore, as president, and James Douglas of New York as one of the incorporators. This institute has obtained the right to mine the carnotite ores on twenty-seven different claims in the Paradox Valley for a period of three years. A mill for the concentration of the ores and the extraction of radium is now being built in Denver. The institute has been formed for the special purpose of procuring enough radium to conduct extensive experiments in radium therapy with special reference to curing cancer. The extraction of the radium from the carnotite ores will be made by the Bureau of Mines for the Institute.

Less Than Two Grammes of Radium in United States.

There are certain facts to be borne in mind in regard to the radium situation, and the first and most important is that there are less than two grammes of radium in the entire United States at the present time. In the entire world, the supply is estimated at 30 grammes, and the great bulk of this came from American ores. It is stated on authority that not more than two American physicians have enough radium to use in the treatment of cancer. One of these is Dr. Kelly, the famous Baltimore surgeon, and he has more than half the entire supply in the entire country. He declares that instead of one gramme, he should have ten grammes.

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

A New Governor for Motor Vehicle Control

An automatic governor is necessary for power vehicles not only on the score of prolonging the life of the motor, but also on the score of fuel economy.

But the automatic governors employed to-day do not assist the driver in the operation of the vehicle. They are merely speed limiters, and as such they may be divided into two classes, namely: governors which limit the motor speed directly, through curtailing the gas flow, and indirectly the vehicle speed; and governors which limit the vehicle speed directly through its influence on the motor, and indirectly the motor speed, through curtailing the gas supply, or by grounding the ignition The non-ignition method, owing to the many and serious objections to it, can have only a very limited application, and will not be considered here

It is conceded generally that these governors have serious limitations, yet it has been the policy of many designers to provide their vehicles with them on the assumption that the disadvantages resulting from omitting them would be far more serious than those from using them.

The requirements of an efficient motor vehicle governor are that it accomplish at least five things; first, it should provide a positive control of the maximum speed of the motor, at all times, whether running idle or under load; second, it should permit of different maximum motor speeds for the different gears, and it should confine those speeds, so far as possible, considering the power requirements for the different gears, to within that zone of motor speeds corresponding to the highest motor efficiency; third, it should do this through a mechanism capable of simple and accurate adjustment whereby the maximum speed of the motor, and the maximum speed of the vehicle, may be raised or lowered at will to suit the varying conditions of service for which the vehicle has been designed, or provided; fourth, it should provide a valve mechanism, free from fluttering tendencies, which will effectively and economically feed the gas mixture to the motor only in such amounts as may be needed to develop and to maintain the desired power, and no more; and, fifth, all of these functions should be included in a mechanism of such simple design and substantial construction as to be fool-proof and tamper-proof, and capable of being locked, or sealed

The need of such a governor has been keenly felt in the vehicle industry, and yet no progress seems to have been made in evolving such a design until the recent advent of what is known as the duplex governor, which is now undergoing some severe trials by several of the large commercial vehicle manufacturers, and the reports concerning which are said to be very satisfactory

This governor was designed on the principle of a dual actuating influence. This double influence consists of a motor influence, as to its speed, which is imparted to the governor, and a vehicle influence, as to its speed, which is also imparted to the governor. The motor speed may be conveyed from the timing gears, magneto shaft, etc., and the vehicle speed from the propellor-shaft, or jack-shaft. The conveying speed means consists of a one quarter inch, sixteen strand, steel cable revolving in a hard fiber, or metallic casing The centrifugal member, valve member, and adjusting member are all consolidated into a single unit within an inclosing shell which is interposed between the carbureter and the intake manifold of the motor, in such a manner that the entire gas supply must pass through the valve.

On each side of the valve chamber provision is made for the insertion of a speed terminal, one conveying to the governor a proportionate vehicle speed, and the other conveying a proportionate motor speed Within the governor there are two automatically acting one-way clutches, the floating members of which consist of gears in mesh with a third gear mounted on the centrifugal governor spindle. These clutches are so designed as to impart to the centrifugal member that of the two speeds which is the higher. With the motor running idle the motor speed will actuate the governor, and the motor is always under governor control. When the vehicle is in motion, and is being propelled by the motor on high gears, the speed imparted to the governor by the vehicle will be the higher speed and will govern the motor, whereas on low gears the motor speed will be the higher and will govern the motor.

The governing valve employed is a grid valve of special construction and is said to be entirely new in the industry. It consists of a fixed part set into the upper part of the valve chamber and provided with elongated slots having flaring walls from its under surface outward. Below this fixed part a movable part, provided with a corresponding series of slots having flaring walls from its upper surface downward, has an arc movement along the line of the minor axes of the slots, or across them, and is supported by means of a substantial bearing The maximum travel of this movable part is less than one eighth of an inch; yet that small travel effects all degrees of aperture between full open and full closed valve When the openings of the rigid part coincide with the openings of the movable part the valve is open, and when the bars of the rigid part cover the openings of the movable part, and *vice versa*, the valve is closed. The two parts of the valve have a ground fit. The movable part is held in open position by means of spring pressure, and its possible motion, in both directions, is limited by suitable adjusting screws

A new type of gasoline engine governor.

How the governor is applied to an automobile engine.

The influence of the centrifugal member, as a result of the speeds imparted to it, is to develop a pressure sufficient to overcome the spring pressure tending to hold the valve in its open position, and to close the valve. As soon as this pressure is removed the movable valve part is released, and returns to its full open position. The adjustment factor is constant for all speeds. The increase of the centrifugal pressure, as the square of the speed increases, is balanced by a spring pressure tending to return the centrifugal weights to their negative position, plus the spring pressure of the movable valve part. The working combination between the centrifugal member and movable valve part is influenced by the adjusting screw. The locking yoke may be removed and the hand-wheel turned to the right, in which case the possible vehicle and motor speeds are reduced, and if turned to the left, they are increased. This results from the lengthening or shortening of the valve stem, and thus increasing or decreasing the required travel of a floating collar, carried by the centrifugal member, to influence the position of the valve.

It is claimed that the construction of the valve and its actuating influence are such as to free it from all vibration; its movable part is balanced, and its center of gravity lies within its center of support. The openings of the valve parts, when superimposed, are so designed as to constitute elongated venturi with a view to wire-pulling all of the gas passing through the valve, and for the further purpose, through the flare of the walls of the openings, to establish slight cross currents in the gas flow to promote the better commingling of its ingredients.

The centrifugal member revolves in a chamber entirely separated from the gas chamber, and in an oil bath. This chamber contains all of the moving parts of the unit, except the valve and yoke parts in the valve chamber, which have a maximum movement of less than one eighth of an inch. A screw cap is provided to cover the adjusting means, which may be locked or sealed.

Among other vehicles the governor was applied to a five-ton truck. Before the application a careful service run of the truck was made across country with a gross load of 10,000 pounds, and without a governor. The motor control was by hand and pedal with a very careful effort made to maintain a speed of 9.5 miles per hour, and not to exceed it A record was kept of the other factors of the performance. The governor was applied and a corresponding, and in every way similar, run was made over the same roads and for the same distance with the result that it was done in 21 per cent less time, with an average speed of 8.85 miles per hour, as against an average of 7.5 miles per hour of the previous run; with 20 per cent less gasoline; with an average reduction of 10 per cent of radiator temperature; and 5 per cent less piston travel. Of the hills on which it was necessary to drop below third gear without the governor, 70 per cent were made on third gear, proving thereby that the automatic control was to that extent more efficient than the personal control. This resulted largely from the fact that the best of drivers will misjudge their grade and road resistances and will not work for any length of time at a high efficiency, whereas with the automatic control the vehicle is kept up to its best performance, and when it reaches a grade it has its maximum momentum, the motor is turning over at its maximum speed for that gear, the motor is being given just as much gas as it will take to maintain that speed, and without either starving or loading-up tendencies.

When the governor was applied to a pleasure vehicle (a six-cylinder roadster), in which the maximum vehicle speed is limited to thirty miles per hour and the maximum motor speed to 1,000 revolutions per minute, it was demonstrated that the maximum vehicle speed can be maintained on fourth and third gears, on which gears the vehicle controls the motor, and on the other gears a reduced, but relatively high speed can be maintained with almost 100 per cent increase of power

(Concluded on page 15[illegible].)

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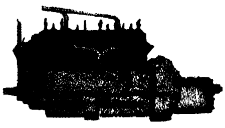
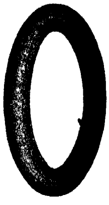
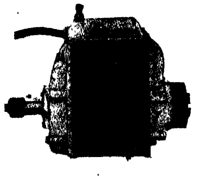


THE GASOLENE MOTOR—We might have had motor cars without the gasolene engine. Steam or electricity might have served as the motive power—but they would not have been the splendid high powered, flexible machines that have so revolutionized our ideas of time and distance. The gasolene engine is fundamental to the automobile as we know it today.



THE PNEUMATIC TIRE—But even with the gasolene engine simplified and perfected to its highest efficiency its usefulness would have been sadly curtailed had not the pneumatic tire come to make its full development possible. The pneumatic tire, too, is fundamental to the twentieth century automobile.



THE DELCO SYSTEM—The Delco System has been the refining influence in the development of the gasolene car. It has eliminated the crudities of the crank and of hand lighted lamps. It has provided an ignition that is thoroughly dependable under all sorts of operating conditions. It has furnished an always available auxiliary power that removes the danger of accident when the engine stalls unexpectedly in a tight place. It has immeasurably broadened the scope of the automobile by making it so easy and safe to operate that almost any one can readily master it.

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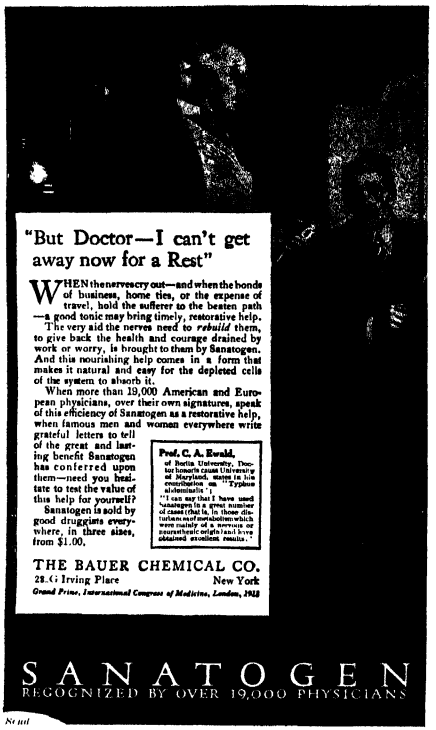

"But Doctor—I can't get away now for a Rest"

WHEN the nerves cry out—and when the bonds of business, home ties, or the expense of travel, hold the sufferer to the beaten path—a good tonic may bring timely, restorative help.

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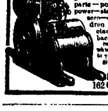

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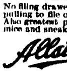

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The Hope-Jones Orchestra

(Concluded from page 137)

There is also an armature disk valve *M* made of soft Swedish charcoal iron that rests normally upon a hollowed metal cap *N*, which is perforated by two crescent shaped openings. Directly above this disk there is an electro magnet *Z* fixed rigidly into a metal plate.

Under normal conditions the weight of the armature disk valve causes it to remain seated upon the raised faces of the cap seat *N* in such a manner that the compressed air contained in the wind chest *B* passes between the poles of the electro magnet, fills the cavity in the cap seat *N* and then passes, by means of the passage *P*, into the primary pneumatic bellows or motor *Q*. When the musician depresses one of the keys on his keyboard an electric contact is established and a current at about 10 volts pressure flows through the flexible cable connecting his keyboard with the instrument proper, and by energizing the electro magnet, raises the armature disk valve *M* so that no more compressed air can flow from the wind chest *B* into the passage *P*. Hence, the compressed air already in the primary bellows *Q* escapes to the atmosphere through the passage *P*. This results in the collapse of the pneumatic motor *E* and the consequent lifting of the valve spindle *H* (as described before), producing sound in the organ pipe *J*

In the above mechanism the areas of the various channels, valves, pneumatic motors, etc, bear a carefully calculated relation one to the other, with the result that a seemingly incredible speed of action is obtained Tests by means of revolving toothed wheels have shown that an organ pipe may be made to give its full tone and assume silence no less than 300 times per second

The initial pressure admitted to the pipe for a small fraction of a second is considerably greater than the pressure of the compressed air in the chest *B*, thus giving what the inventor describes as a "pneumatic blow" to start the speech of his pipes. This wonderfully rapid action has entirely altered the organ as a musical instrument. It places the musician in such intimate touch with his pipes that he is, within certain bounds, able to produce accents and many other variations. Every pipe and other tone-producer in the instrument is equipped with an electro-pneumatic lever described above, and under its control.

The keys which the musician operates are made very short and as light as is practicable, with the object of eliminating inertia. Upon pressing the key, contact is made between a bar of silver attached to the key and a number of very fine silver wires secured to the key frame. Through the contact thus made, the electric current passes to an electro-pneumatic relay which closes from 10 to 30 similar silver contacts, according to the size of the instrument. The current then passes through a multiple switch to the electro-pneumatic lever controlling its appropriate pipe.

The multiple switch last referred to can be closed or opened by means of one of the stop keys arranged in a semi-circle just below the music desk.

Each one of the key boards upon which the musician plays, including the large one operated by his feet, is fitted with a double touch The key descends in the ordinary manner to its usual depth; it then meets a small lever held firmly in place by a spring already under tension. If the musician presses one of his keys with greatly increased force, this small lever and spring will be overcome and the key will fall another sixteenth of an inch, thereby giving an additional second touch contact to cause some other pipe or tone producer to give a different quality of tone.

All the keys are also fitted with a pizzicato touch which can be switched on and off by the musician. When brought into operation the current, supplied through one of the silver contacts below the keys, flows for an instant to the electro-pneumatic lever controlling an additional set of pipes or other tone producers.

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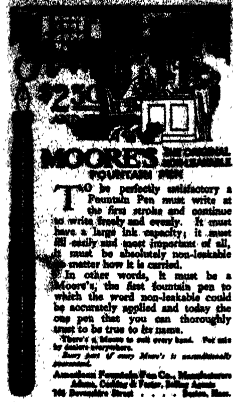

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[illegible] APPROVAL [illegible]

But as soon as the first tone commences again the second is immediately cut off. When a certain number of pipes are responding normally to the keys and certain others are responding through the pizzicato touch, the attack or spit of certain instruments of the orchestra is very closely imitated. Other novel and charming musical effects may also be produced.

To what greater degree the instrument may be still further improved can hardly be predicted, for now almost anything seems possible. At present it is possible to obtain the effects of as many as 150 instruments in all their varying tones, and further, these effects can be only such as are reproduced by the very finest artists. It will be of great interest to the scientific as well as the musical world to watch the further work of Mr. Hope-Jones.

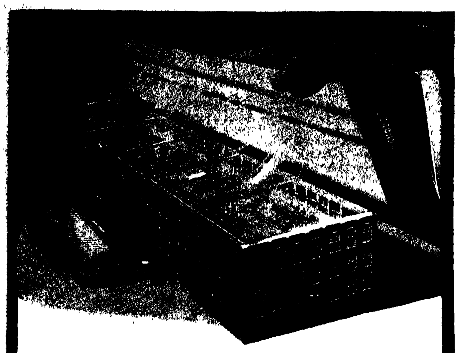
Eliminating the Flicker from the Moving Picture

(*Concluded from page 148.*)

ward at one half the angular velocity at which the film travels. The annexed drawings of a vanoscope apparatus of earlier design, equipped with two half-circle instead of four quarter-circle mirrors, show the succession of events by perspective and side views. In the perspective view of Fig. 1 the picture *A* is being projected by mirror *A* through the lens to the screens; the side view shows the position of the mirrors (exaggerated for clearness) when picture *A* is being projected solely by mirror *A*. Fig. 2 shows the conditions after the film has been moved forward a short distance, and mirror *A* has been rotated to a point where it is about to pass out of the field of light; and mirror *A* has also been rocked forward, as shown in the side view, at one half the angular velocity of the film, so that the picture as projected has been continued as a stationary image on the screen. Fig. 3 shows picture *A* after the film has moved still farther forward and mirror *A* has been rotated to a position partly out of the light field. The whole of the picture is still being projected upon the screen by this mirror, but the image is only partially as *brilliant* as it was when the mirror was fully exposed to the light; and picture *B* is now also being projected, with partial illumination, by mirror *B*, and is gradually increasing in brilliancy in proportion as the illumination from mirror *A* is decreasing. The actual image on the screen is therefore now made up of both picture *A* and picture *B*. It is in fact a composite of them both, the pair making together 100 per cent of illumination in a dissolving picture. As one mirror segment moves out of the field the lessened illumination is compensated for by the increased illumination of the next mirror segment moving into the field.

Whereas in the ordinary motion picture apparatus the illusion of continuity is a physiological effect, in the new system this illusion is largely produced as an optical effect in the apparatus. Persistence of visual impression is not so severely taxed, and in the co-operation of machine and eye the machine does a much greater part of the work than it does in the old system. The picture appears to "stand out" from the screen, owing to the heightening of verisimilitude by the presence of two dissolving images.

Fire danger is almost eliminated, because for given average screen illumination the amount of light (and heat) to which the film is subjected is not as intense as in the present system. In ordinary projecting the film is always moving continuously, not intermittently, so that the heat that does impinge on the celluloid strip does not have time to raise any point to anywhere near the igniting temperature. The lessened heat allows the feed of the moving film to be varied at will, and allows the film to be stopped at any desired point, as in the analysis of complex manual or mechanical motions or in nature study. The absence of sudden start and stop of the film eliminates the need of looping the film, renders the machine noiseless and free from the tremor which often makes the screen image indistinct, and saves the surface of the film from



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Governor for Motor Vehicles

(Concluded from page 142.)

output of the motor above its possible output on high gear.

It is claimed by the inventor, as the result of actual practice both on the pleasure car and on heavy vehicles, that the maximum variation in speed, with throttle wide open, both on climbing and descending normal grades, within the power and compression limits of their respective motors, will fall within a plus or minus five per cent. Where the vehicle speed is low, as in the case of a commercial vehicle, it is recommended that the car be speeded to its desired maximum and then run on full throttle under governor control. With pleasure vehicles on open highways this plan is also feasible. It makes the driving of the car simpler and frees the driver from a great deal of nervous tension and strain which is very trying in a full day's operation.

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Platinum Deposits

IMPORTANT deposits of platinum have been discovered at Wenden, Westphalia, in a region previously well known for its deposits of other metals. A territory of 500 acres has been examined and the borings from nine different drill holes show the presence of from 0.9 to 1.9 troy ounces of platinum per cubic yard, which is said to be a higher content than in the Russian deposits of this valuable metal. The actual extent of the German deposits is not even vaguely known as yet, but Mr Thomas H. Norton, American consul at Chemnitz, who has made a report on this discovery, thinks that the platinum market is likely to be profoundly affected. It appears that the metal was found alloyed with silver, and therefore would have escaped detection in an ordinary ore analysis, as in this state it is dissolved by nitric acid. The consul (who is a chemical expert) suggests that the German discovery will lead to a revision of rock analysis in other parts of the world, with the possible result of platinum being found to be a much commoner metal than it is now supposed to be. The diminishing supply of platinum has long been a serious economic problem. The present annual production is about 13,250 pounds, 95 per cent of which comes from Russia. The demand far exceeds the supply, and the price has advanced since 1892 from $89 to $488 per troy pound. The unique value of platinum depends upon the fact that its coefficient of expansion is the same as that of glass and of the materials used by dentists for artificial teeth. About one-third of the world's supply is used in the electro-technical industries, and another one third in dentistry.

Beet Sugar Industry in Great Britain

THE question of establishing this industry in the British Isles has been agitated for a quarter of a century without any tangible results until recently. Under the auspices of the British Beet Sugar Council, organized in 1910, experimental crops were grown so successfully that at the end of 1911 a large company was formed, which erected a factory at Cantley, Norfolk, and contracted for the produce of 3,366 acres. In 1913, about 4,500 acres were under cultivation for the company, and the crop was about 60,000 tons. Experienced beet farm hands have been imported from Holland to aid and instruct the English laborers. The new industry is therefore now well established in Great Britain, where it bids fair to modify materially the present economic organization of the rural districts.

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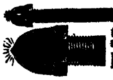

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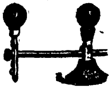

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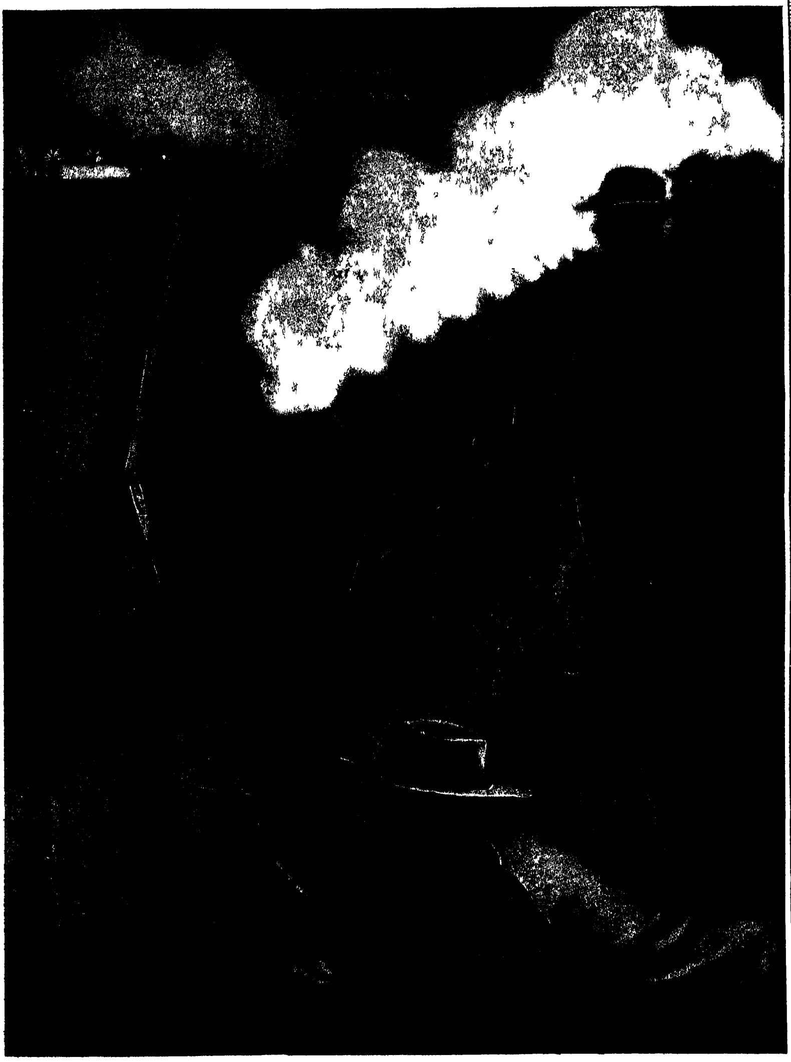

Vol. CX No. 8
February 21, 1914

Munn & Co., Inc., Publishers
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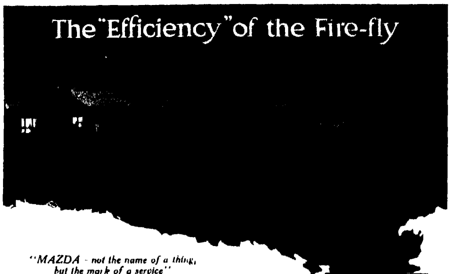
The "Efficiency" of the Fire-fly



"MAZDA — not the name of a thing, but the mark of a service"

PRIMITIVE man once used lanterns holding swarms of fireflies to guide him when he went forth at night.

Today, as Waldemar Kaempffert points out in an article on "The Light of Our Descendants" printed by the *Outlook*, the illuminating specialists of two continents are studying the firefly for a solution of one of mankind's greatest problems —artificial light

To imitate the firefly—to get a great deal of light with but little heat waste—has been the steadfast aim of technical experts in electric lighting since the study of electric light became a science

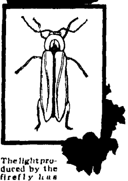
Step by step science has advanced in its search for this *economy in the fuel of life.*

That is what the much used word "efficiency" means to electric lighting science—*more light without increasing cost.*

The farthest advance in this study of lighting economy has been reached in the work of the famous group of scientists in the Research Laboratories of the General Electric Company at Schenectady These experts selected and approved the features of a lamp that gives a beautiful light—*three times as much light,* with the same amount of current, as you get from the old style carbon lamp

On the bulb of this lamp is etched the mark "MAZDA"

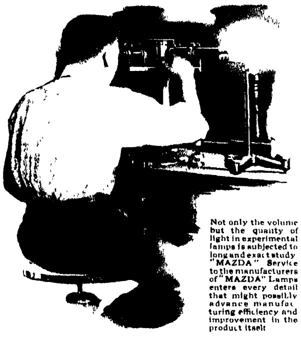
"MAZDA" is the mark of a Service It tells you of the great work that these busy men have done for the manufacturers of "MAZDA" lamps It tells you what they are doing while you are reading this article It tells you also of what they will be doing to-morrow, and next month, and next year, because it is the trade mark designation of the incessant effort "MAZDA" Service is making toward the ideal light.



The light produced by the firefly has challenged the lamp experts of two continents

On the lamps themselves the mark "MAZDA" means the selection of every "efficiency" discovery these Research Laboratories may find applicable and practical. Not content with wide investigation and experiment in these Research Laboratories, and in the active developing and manufacturing centers at Harrison and Cleveland, there is close touch also with progress that may be made by great experimental laboratories of Europe

From whatever source the new knowledge comes it is impartially considered with reference to its possible value in enabling the manufacturers to produce for you a lamp more "efficient" or adaptable The proved advances, year after year, are transmitted by this "MAZDA" Service to the General Electric Company factories and the factories of other Companies entitled to receive this Service.



Not only the volume but the quality of light in experimental lamps is subjected to long and exact study "MAZDA" Service to the manufacturers of "MAZDA" Lamps enters every detail that might possibly advance manufacturing efficiency and improvement in the product itself

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No. 1661—**Distillation of soft wood,** and gives the proportions and quantities of each product obtainable, and the various processes used.

Nos. 1723 and 1724—The general subject of the utilization of wood wastes, **giving all the products** by a clear and valuable diagram showing their relations to each other, and many illustrations of apparatus.

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No. 1656—Turpentine from waste wood

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VOLUME CX]
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NEW YORK, FEBRUARY 21, 1914

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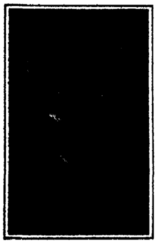
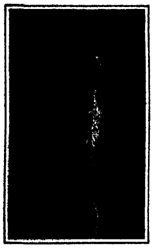
Blind visitors listening to a lecture before examining a human skeleton. The demonstration is preceded by a short lecture by a capable local specialist.



Blind men studying the form and mechanism of firearms.

"Now we know how big a lion is, but we couldn't ride a live one, could we?" Blind children making an interesting study in natural history.

Gaining impressions of a bridge and a locomotive engine, through step by step patient examination of the structural difficulties of the parts and sections.



The human skeleton. An investigation into what it is like.

"What should I see if I saw an aeroplane?" An object lesson for boys by a demonstrator who guides the hand over the features of the specimen.

Showing Museums to the Blind

By Percy Collins

MUCH has been done in all civilized countries to alleviate the hard lot of the blind, but it has been left to Mr. J. A. Charlton Deas, of Sunderland (England) to point out that the educational advantages of our museums and art galleries may be made available to the sightless members of the community. At first thought this assertion seems hard to credit. But Mr. Deas, who is librarian and museum director to the Corporation of Sunderland, has put his theories to the test, and has proved their soundness beyond all possibility of quibble. Briefly, the methods he adopts are as follows: Each demonstration is preceded by a short lecture, delivered in simple language by capable local specialists—the information given being just that interesting outline which is required by a person approaching a subject for the first time. At the close of the lecture, each blind person is taken in hand by a competent guide—one of a body of ladies and gentlemen whose co-operation had previously been secured. The business of the guides is to assist their charges to examine the series of specimens set forth for their edification. Attached to each specimen is a carefully prepared descriptive label. This is read aloud by the guide, and supplemented by any interesting knowledge of the object which he or she may possess. The hands or fingers of the blind person are then guided to the important features of the specimen. "This conscientious guiding of the blind person's hands," writes Mr. Deas, "is by no means a simple matter. When it is remembered that the voice must be used to explain each feature at the moment of touch, and that in this way only one person can be satisfactorily dealt with at a time, it will be realised that an afternoon of such work is not without its fatigue, but a fatigue that is more than recompensed by the most convincing expressions of gratitude on the part of the recipient."

In order that each blind visitor should have an opportunity to examine every object, a small card giving a list of the specimens is attached to the coat-lapel or dress, and each item is ticked off when it has been thoroughly handled. The foregoing remarks apply specially to the adult blind, who were invited to attend demonstrations on Sunday afternoons. On the Mondays following, however, the same programme was gone through for the benefit of blind children from the Council School. At these juvenile demonstrations an expert blind teacher was present, who, having already heard the lecture on the previous day, was well able to bring out the points that he knew from experience would be specially interesting to his young charges, and to explain them in a comprehensible manner. It is a noteworthy fact that many blind children are remarkably quick to assimilate instruction, and use their hands with great dexterity; a point which seems to support the views of Dr. Montessori, the new educationist, who claims that the natural way for little ones to learn about things is to touch them.

Mr. G. I. Walker (the expert blind teacher of the blind referred to above), in a letter to Mr. Deas, writes: "The satisfactory point in connection with the demonstrations is that the interest has deepened as time has passed. Discussions in the Blind Institute and elsewhere have become varied and interesting, and show that the minds of those attending have been awakened and stimulated, and made to understand that they are indeed deficient, and sadly ignorant of what is around them. This has not produced any appreciable sense of bitterness and discomfort, but has made them more sensible of the kindness and thoughtfulness that have so generously sought to bring them into contact with so many things in such pleasant fashion."

The Center of the Stars

IN a communication to the Royal Astronomical Society Mr. Turner has shown that there is a center to the stellar universe such that as we recede from it the stars become fewer in number and their velocities decrease. He shows that the division of the celestial bodies into two classes, of which the members of one class approach the center while the members of the other class recede from it, give to the terrestrial observer the appearance of their being two main directions. On this theory is explainable the relation between the velocities of the stars and the nature of their spectra, the birth of movements of rotation in opposite directions in the same nebula and the occurrences of a preponderating number of new stars in the constellation Gemini. The direction thus found for the center of the stellar universe differs but little from that deduced by Mr. Lewis from statistical observations on double stars.

Staircase Drawers

A SOMEWHAT curious idea is to put drawers in the staircase and so make use of otherwise wasted space. This may prove to be quite useful in some cases, especially in small modern houses, where even the least space needs to be made use of, owing to the lack of cupboards, which are generally absent. Drawers of this kind can be made to hold all kinds of household cleaning material, brushes, dusters and the like, as well as many objects that are not often needed. One point is that the drawers should be kept tight shut, for there is always plenty of dust on the staircase, and again, should one of them be left open, it might trip up a person who is going downstairs.

Congress on Hygiene and Demography.—The Government Printing Office, in Washington, has just completed the publication of the Transactions of the Fifteenth International Congress on Hygiene and Demography, Washington, September 23-28th, 1912. It is a voluminous document, comprising 6 volumes, some of which are in 2 parts each, so that there are 9 large books in all. This work is being distributed by the secretary general of the Congress, Dr. John S. Fulton, Maltby Building, Washington, D. C.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

President Wilson on Canal Tolls

EVERY high-minded American citizen, who puts the honor and fair name of his country above every other consideration, must have felt a heavy burden lifted from his national conscience when he learned that President Wilson favors the repeal at this session of Congress of the provision of the Panama Canal Act exempting American coastwise vessels from the payment of tolls. Mr Wilson, who had already shown himself to be one of the most just, fearless and powerful Presidents that have filled the Executive Office, has expressed his determination that the iniquitous canal toll act shall be rescinded, and in bringing his powerful hand to bear upon Congress in this matter, we believe that he will have American public opinion behind him.

Anyone with common sense and an elementary sense of honor does not have to look very far into this question to see that it involves a distinct and deliberate breach of national good faith. In the year 1901 there was a treaty concluded between the United States and Great Britain, known as the "Hay-Pauncefote Treaty," in which, in view of Great Britain's agreeing to give up certain rights which she possessed at the Isthmus of Panama, the United States agreed to operate the canal under similar working conditions as regards the ships of all nations making use of the canal. This will be readily understood if we quote article 3 of the above treaty, which reads as follows: "The United States adopts as the basis of the neutralization of such ship canal the following rule, substantially as embodied in the convention of Constantinople, signed the 28th of October, 1888, for the free navigation of the Suez Canal, that is to say: 1. The canal shall be free and open to the vessels of commerce and of war of all nations observing these rules on terms of entire equality, so that there shall be no discrimination against any such nation or its citizens or subjects, in respect of the conditions or charges of traffic or otherwise"

Now one does not have to be a lawyer to see that the passage of a law last year which exempted the ships of our coastwise traffic from paying tolls and imposed tolls on the ships of other nations was a distinct breach of faith on the part of our Government. The question is one of plain day-by-day morality; matters of moral right are universal in their application; and the code of honor is just as strict in its obligations on a powerful government like our own, as it is upon the individual citizen Nay, is it not infinitely more binding? A breach of faith on the part of one man concerns himself only; but a breach of faith on the part of our Government reflects upon every one of the one hundred millions of people who live beneath its flag.

In some of the written and spoken discussions of this canal act as expressed on the platform and even in Congress itself, there has been exhibited a *naive moral* obliquity which would be regrettable in a child, bewildering in an adult, and is shocking and humiliating when it is found in the august halls of Congress

Specious catchwords and misleading phraseology may easily divert the minds of a busy people from the real points at issue in a controversy of this kind. "We built the canal; why should we not make the other people pay for it?" "The United States has invested nearly $400,000,000 in this enterprise; and why should we be called upon to play the part of the philanthropic benefactor by charging our own ships the same rate of toll as we charge the ships of other nations who have contributed not a single dollar to the great work?" The answer to this is that after a careful review of the situation, and in view of the advantages to be secured by the abrogation of previously existing treaties affecting the Isthmus, and in view of the pledge of Great Britain that the Canadian and Suez canals shall be operated on terms of equality, the United States did enter into a solemn agreement to operate the Panama Canal upon terms of equality, and the passage of the recent act exempting our ships has placed us in a most deplorable situation in the eyes of the world, as having committed an act of international dishonor.

Furthermore, the President speaks of the exemption of our coastwise shipping from canal tolls as economically unjust. It certainly is. Such exemption would be simply to divert a portion of the reasonable profits of the canal into the pockets of certain private corporations. We cannot shut our eyes to this fact The remission of these tolls will not mean the return of any profits of operation back to the National Treasury; and no amount of argument can prove that it will.

These, however, are entirely secondary considerations in view of the fact that the obnoxious act of last year has awakened throughout the world a distrust of our national good faith. "Let justice prevail though the heavens should fall," says the ancient adage, and a sentiment that was strong then is doubly binding today in an age that boasts of its advanced civilization.

There will be a fight to uphold this act exempting coastwise shipping—a bitter fight, no doubt; but with the President himself so strongly on the side of fair dealing, backed as he undoubtedly is, by the sentiment of the large majority of the nation, we look confidently for the repeal of an act which should never have been allowed to cast its shadow upon the history of our Federal legislation.

Pittsburgh's Smoke Bill

SMOKING is a costly habit, whether the smoker happens to be a man or a town. Persons who have hitherto regarded the "smoke nuisance" as mainly an æsthetic problem will be startled by the revelations of Mr. J. J. O'Connor, Jr., who has been investigating the smoke of Pittsburgh from the practical viewpoint of dollars and cents.

Here are the items of Pittsburgh's yearly smoke bill:

Cost to the smoke maker in the imperfect combustion of fuel (of which smoke is the outward and visible sign), $1,520,740 Better methods of stoking would not only do away with most of the smoke, but would effect a saving of 21 7 per cent in the present fuel consumption; in other words, about one fifth of the utilizable fuel of Pittsburgh factories now "goes up in smoke" and is a dead loss.

Cost to the individual citizen: (1) laundry bills, $1,500,000; (2) dry cleaning bills, $750,000. These figures do not represent the total laundry and cleaning business of the city, but merely the excess over what these items would be under ideal conditions of smoke regulation. The same principle applies to the figures quoted below in connection with other economic effects of the smoke nuisance. Pittsburgh is the greatest laundry town in the country, notwithstanding the fact that, with its large population of unskilled laborers, it has a greater percentage of citizens who do not patronize the laundries than almost any other city. The annual per capita laundry business is $3 12; about one third greater than that of the average American city Dry cleaning bills are far larger in Pittsburgh than in most other cities, despite the fact that Pittsburghers generally eschew light-colored clothing to such an extent that their city has come to be known as "the mourning town."

Cost to the household: (1) exterior painting, $330,000; (2) sheet metal work, $1,008,000; (3) cleaning and renewing wall paper, $550,000; (4) cleaning and renewing lace curtains, $300,000; (5) artificial lighting, $84,000. Houses in Pittsburgh are painted every three years, while in most other cities the houses are painted every six or eight years. The sheet metal of roofs, gutters, spouts, etc., deteriorates twice as fast in the smoky atmosphere of Pittsburgh as in cities of average freedom from smoke, and therefore needs to be renewed twice as often. It also needs repainting about twice as often. About 10,000 Pittsburgh households have their wall paper cleaned once or twice a year by a professional cleaner—a functionary who is unknown in most other cities. Pittsburgh walls are repapered every two years; in other cities from six to ten years is the average. Lace curtains are washed in Pittsburgh three or four times a year, and silk curtains every two to four weeks. The greatest cost in this connection is due to the rapid wearing out entailed in frequent washing. The necessity for excessive artificial lighting in a smoky atmosphere is obvious.

Cost to wholesale and retail stores: (1) merchandise, $1,650,000; (2) extra precautions, $450,000; (3) cleaning, $750,000; (4) artificial lighting, $650,000; (5) department stores, $175,000. Annual damage to merchandise due to smoke in typical stores, exclusive of department stores, ranges from $75 in a drug concern up to $1,500 at a haberdasher's, [illegible] at a grocer's, and $3,000 at a stationer's. The extra precautions to prevent damage to goods by smoke include additional labor, extra wrapping of cloth, books, or other articles when stored, screens to keep out dirt, coverings for goods, weather strips on windows, etc. The extra cost of cleaning requires no explanation. As to item (4), it is stated that 30 per cent of the artificial lighting in Pittsburgh is required by atmospheric conditions for which smoke is responsible. Under this item account is taken not only of the effects of diminished daylight, but also of the reduced efficiency of electric and other lamps resulting from the accumulation of soot on globes and shades. The losses experienced by department stores have been reckoned separately on account of the diversity of their stocks. These stores report damage to merchandise running up to $25,000, and other items in proportion.

Cost to semi-public buildings: (1) office buildings, $90,000; (2) hotels, $22,000; (3) hospitals, [illegible] The additional expense in these cases is analogous in its causes to that borne by private houses. It is found that Pittsburgh office buildings use 15 pounds of cleaning powder per thousand square feet per month, as against 11 required in New York, Boston, Philadelphia, Baltimore, or Washington.

The total bill foots up $9,944,740 per annum; and no attempt has been made to include such items as depreciation in the value of property, absence of various industries which are practically excluded by a smoky atmosphere, and, last but not least, injury to human health.

Rewards to Postal Employees for Inventions

THE appropriation act for the Post Office Department for the year ending June 30th, 1914, authorizes the Postmaster General to offer and pay periodically a cash reward for the invention, suggestion or series of suggestions for an improvement or economy applicable to the postal service submitted by one or more employees of the Post Office Department which shall be deemed the most valuable of those submitted and adopted for use, and for that purpose the sum of $10,000 has been appropriated

To obtain the reward the winning suggestion or invention must be one that will clearly effect a material economy or increase efficiency. The sum to be awarded as above to employees is in addition to their usual compensation. The total amount to be paid in any one month or for any one invention or suggestion is not to exceed $1,000.

It is provided that no employee shall be paid a reward under the act until he has quit-claimed any further claim by him or his heirs or assigns and executed an agreement that no application for patent has been made for any such invention. It does not appear that the act requires that the employee or employees submitting the invention or suggestion shall be an inventor or originator. The prohibition of patent application is unfortunate, since such application leads to the only means provided by law for the judicial determination of priority of invention in case of a contest. In any event, it seems unwise for the Government by one legislative act to deprive an inventor of the benefits of another act, especially since the invention submitted for postal purposes might have a greater usefulness outside of such service and its benefit to the limited service would not be lessened by its more extensive employment elsewhere. A committee has been appointed by Postmaster General Burleson to consider and pass upon the merits of such improvements as may be submitted under the provision of the act.

The Problem of Three Bodies.

THE mathematical problem known as the three bodies has resisted the attempts to solve it made by mathematicians from Lagrange to Poincaré. It has now at last been solved. This immensely difficult problem seems very simple. The problem is to express the motions of three bodies of any masses under the action of their mutual attractions, the attractions obeying, of course, Newton's law of gravitation. Poincaré, the great French mathematician, who has just died, did an immense amount of work on this problem, and although not completely solving it, obtained some very valuable results. He showed that in certain circumstances the bodies would be in the same positions again and again; in other words, that there existed periodic solutions. He also showed that a very remarkable case could exist where the bodies would first describe orbits which were nearly periodic, then gradually depart from the periodic form, and then again, after an immense lapse of time, approach the periodic form. But all these solutions broke down when the bodies actually came into collision. It has been reserved for Mr. Sundmann, astronomer at Helsingfors, to evolve a solution which remains true after the bodies have been in collision and thus to obtain a complete solution of this famous and seemingly unsolvable problem.

Engineering

Rapid Loading of a Steamer.—What is surely a record for speedy loading is that held by the Great Lakes steamship "William E. Corey," which when at Two Harbors, Minnesota, took 10,100 tons of iron ore into her hold in 26 minutes. The "Corey" is of the hopper bottom type of construction.

New York Harbor to Get $500,000.—A good start in the improvement of New York harbor has been made through the grant of $500,000 by Congress as an initial appropriation for the East River improvement project, recently urged by the Mayor of this city. The project calls for blasting away Coenties Reef and Diamond Shoal off the Battery, and the removal of other rocks in the river which have proved dangerous to navigation.

Increasing Size of Steam Turbines.—There is an extraordinary development taking place in the size of the individual unit in the field of steam turbines. We were commenting a short while ago on the fact that a unit of 20,000 kilowatts had been built; yet during the past year one of this size and another turbine of 25,000 kilowatts have been built, and it is stated that orders have been placed for four of 30,000 kilowatts and one for 35,000 kilowatts.

Three Boatmen to Each Lifeboat.—It is gratifying to note that the Seamen's Bill provision of "two deckhands to each boat" has been checkmated by the provision of the International Conference that there shall be "not less than three efficient boatmen" for every lifeboat carrying sixty persons and more for larger boats. This will result, as it should, in firemen, stewards, coal passers and other members of the crew qualifying in the handling of boats.

Larger Cylinders for Locomotives.—The Test Department of the Pennsylvania Railroad has been carrying on experiments with superheater locomotives, as a result of which they have determined that when a locomotive is converted from saturated to superheated steam, her cylinders should be enlarged. The results obtained show that, to secure maximum economy, the cyliners should be enlarged to such an extent that the maximum indicated horse-power will be developed at a cut-off not exceeding 30 per cent.

Thousand Foot Drydock for Navy.—In his testimony before the House Naval Affairs Committee, Secretary Daniels advocated the construction at the navy yard, Norfolk, of a drydock of the internal dimensions of the Panama Canal, namely, 1,000 feet long, 110 feet wide, with a depth of 40 feet over the sill. Such a dock would accommodate the largest dreadnought that will ever be built for the United States Navy. That the dimensions are not too great is shown by the fact that some nations, at the present time, are building warships which are considerably over 700 feet in length.

Government Railway for Alaska.—The United States Senate is considering the Alaska Railroad Bill, which involves the expenditure of $35,611,000 for the construction of 733 miles of railroad from a point on the southern coast of Alaska to the Yukon River. It is intended to make only $1,000,000 immediately available. Possibly the Government will take over the 72-mile road which runs from Seward to the north, or the Copper River and Northwestern Railroad, 169 miles long, which runs from Cordova, making the one selected the first division of a general railroad system.

Tenders Derail Trains.—Mr. H. W. Belknap, of the Interstate Commerce Commission, commenting on a wreck last October in which 17 passengers were killed, and 130 passengers and 6 employees injured, finds that the derailment which caused this disaster took place at the forward truck of the tender. He states that on account of the comparatively short wheel base, high center of gravity, and movement of water in the cistern, consisting of surging back and forth and from side to side, the tender is subjected to overturning and derailing forces, which are aggravated by any irregularity which exists in the tracks. Derailments of this kind occur more or less frequently on every large railroad in the country, and they should be given the closest possible study to ascertain their causes and, as far as is practicable, eliminate them.

New Type of Arched Dam Construction.—A new dam has been built in the Big Bear Valley, which proves that, where suitable foundations can be found, it is not necessary to build the huge and costly solid gravity dam, which has hitherto been the prevailing type. The new dam consists of a series of thin arched walls, with the convex faces upstream, which abut against a series of parallel longitudinal walls extending down stream. The latter serve to transfer the thrust of the water to the ground. The new dam has a factor of safety of 13.5, allowing the crushing strength of the concrete to be 3,000 pounds to the square inch. Timidity alone has hitherto prevented engineers from building this type of dam, which is now shown to be perfectly stable, very much stronger than the gravity dam, and cheaper even than the single-arch dam which the present structure replaces at this site.

Electricity

A Wireless Determination of Longitude has been made in French West Africa between Konakry and Kissidugu. Astronomical observations were first made at the two stations; then the Kissidugu chronometer was compared with the Konakry electromagnetic clock by means of wireless signals; and the results were checked by a further set of astronomical observations.

Wireless at the Lindenberg Observatory.—The aerological observatory at Lindenberg, which is the headquarters of Germany's storm-warning service for aeronauts, has been equipped with wireless telegraphy. The new installation will communicate with the wireless outfits on aircraft, and will serve the double purpose of disseminating meteorological information and of warning aeronauts to look out for kite-wires in the neighborhood of the observatory. At night a fixed searchlight and a flashlight are to be used to indicate the position of the observatory, and further aid in preventing collisions with kite-wires.

Electric Automobile Charging Station.—The New York Electric Vehicle Association has issued a booklet containing a list of charging stations within a hundred-mile radius of New York city. Also a map showing the exact location of the charging stations. In the majority of cases under the charging station the following data are given: Maximum amperage available; maximum voltage available; hours during which service is available; prices charged for boosting. The booklet should prove invaluable to owners of electric automobiles in the vicinity of New York, and should do much toward the promotion of the electric vehicle for out of town use.

Efficiency of the Battery-driven Tractor.—About a year ago the Pennsylvania Railroad put into service in Jersey City, N. J., a battery-driven tractor to haul freight cars through the streets. Previous to that the work was done with horses. A report has recently been published on the cost of maintenance and operation of the tractor for seven months. The total cost, including interest and depreciation, is $4,627.88. Had horses been used instead, the cost for the same work would have been $9,179.10, so that the tractor shows a saving for seven months of $4,551.22. Seven thousand seven hundred and twenty-three cars were handled and the cost of the service per car was 0.938 cent, while the cost of the service per ton was 0.028 and per ton mile 0.067 cent.

Heat-storing Magazine.—An inventor in Stockholm, Sweden, has devised an apparatus for storing heat. It consists of a mass of heat-absorbing material, in which is placed a coil of resistance wire. Surrounding the heat-storing material is heat-insulating material, while at the top is a damper which may be operated to permit the heat stored in the magazine to radiate out of the top. The entire apparatus is inclosed in a heat-radiating cover. To facilitate the radiation of heat there is a system of air passages through the heat-storing materials. The apparatus is adapted to be used during off-peak periods, storing heat which may be used as needed. An experimental apparatus about a yard high, 25 inches long and 15 inches wide showed a storing capacity of about 25,000 kilogramme calories, while a temperature in the storing magazine of about 600 deg. Cent. or about 1,100 deg. Fahr. was obtained.

Electric Sterilization of Milk.—The sterilization of milk by electricity without injury to flavor or nutritive qualities bids fair to become a regular practice. Recent attempts to kill the bacteria in milk by brief exposure to the ultra-violet light from a quartz mercury-vapor lamp have attracted considerable interest, but these attempts have not resulted in success. The milk is so opaque to the rays that it was necessary to expose it in thin sheets and then a dangerous fraction of the bacteria escaped the killing process. Another objection has been that the necessary intensity of ultra-violet light gave an unpleasant taste to milk. Another process has been developed at the University of Liverpool under a grant from the City Council and the experiments, carried on for the past two years, are most promising. Exact details of the method have not yet been made public, but it is stated that a high-tension electric current is used and that the exposure is exceedingly brief. The taste of the milk is not changed in the least, nor is the "bouquet" lost. Expert dairymen testified that they could not detect any difference in treated and untreated samples. In fact, the City Analyst found no change in the composition of milk so treated or at least so little as to be negligible. It seems remarkable that the acidity did not increase. Naturally there was no coagulation. Heating was trifling. All pathogenic or dangerous bacteria were killed by the electrification, and it was stated by the scientists that perfect sterilization could be secured with longer treatment. The feeding tests so far have been made on kittens which grew fat on the sterilized milk. Guinea-pigs inoculated with tuberculous milk that had been electrically treated failed to develop the disease. The city of Liverpool has made the investigation official.

Automobile

Wanted: Method of Keeping Seats Dry.—In the city of London, where self-propelled 'buses form such an important part of the transportation system, difficulty has been experienced in keeping dry the outside seats. In consequence, the London General Omnibus Company, which operates by far the greatest number of 'buses, is inviting inventors to submit ideas to overcome the trouble. The ideas should be sent to the chief engineer of the company, whose address is 9 Grosvenor Road, Westminster.

Effect of Corseting on Upholstery.—It has been advanced by persons who are in a position to know that the styles in ladies' corsets exert a marked influence upon the design of automobile upholstery. This is explained by the fact that whereas one style of corset, in vogue to-day, may encourage a luxurious lolling position of the wearer, another style, in vogue to-morrow, may compel a severely upright position. Consequently designers find it incumbent to study other things besides automobile engineering.

Nothing New Under the Sun.—The illustration and description of an electric device to assist carburetion, which was published in our Automobile number, brings to mind that a device of a somewhat similar nature was used as long ago as 1903. It was applied to a surface carbureter on a motor bicycle and consisted briefly of a coil of iron wire wrapped inside the intake pipe. The wire was heated by passing through it a current of electricity from an accumulator. The device worked well but nearly caused an explosion owing to the fact that it created rather too much heat.

A Shortcoming of Cooling Systems.—Despite the plane of perfection to which the modern automobile water cooling system has been brought, the fact nevertheless remains that it has an inherent defect that should be plainly apparent to anyone who has eyes to see. The fan behind the radiator is designed to draw air in through the tubes of the cooler, and because its action cannot be made discriminatory, it continues to invite inside all manner of dust and dirt and winged insects. One foreign manufacturer has eliminated this trouble by causing the air drawn in at the front to be expelled at the sides of the radiator. With the widespread use of radiators, it seems that there is room for the exercise of ingenuity, which almost certainly would be rewarded, for the need of a better method of directing the circulating currents of cool air is real.

Things that Militate Against Pneumatic Engine Starters.—Size and weight of parts, together with a degree of complexity that is permissible only in view of the result accomplished, have militated somewhat against the general use of compressed air engine starting devices. Coupled with these disadvantages there always has been, and probably there always will be, the objectionable propensity of compressed air to escape its bonds on the slightest provocation. It is not the easiest matter in the world to confine compressed air in such a way that the pressure will remain practically constant for long periods, and when the problem is augmented by subjecting the apparatus to the continual vibration that is impossible of elimination in the automobile, the difficulties attendant upon the satisfactory use of air as an engine starting medium are considerably increased.

Electric Lights at Low Cost.—While it goes without saying that an electric lighting system is a most desirable feature in an automobile, the high prices at which most of such systems are offered to the public precludes their use by many owners. Realizing this, a well-known manufacturer of automobile specialties has just brought out a new electric lighting system, of novel construction, the principal feature of which is that it can be installed easily and sells for only $12. The system comprises a dash lamp, a tail light and a portable trouble lamp. The body of each lamp is made of hard rubber instead of metal and contains a powerful lens. The tail lamp has a red lens for the warning signal and a slot underneath, with a white light for illuminating the license plate.

A New Type of Motor Vehicle Tire.—There has appeared upon the market a brand new type of automobile tire in which rubber or rubber compounds of any kind are conspicuous by their absence. Despite this fact, it is said that the shock absorbing proclivities of the tire are quite equal to those of the rubber variety. The tire is composed wholly of cotton fabric which is made waterproof and compressed into a steel rim, the threads running diagonally from tread to base. No adhesives, binders or compounds are used. A somewhat peculiar characteristic of the tire is that after use it picks up a coating of grit and small particles from the road which become partly imbedded in the fabric and sustain much of the wear. The tire has a shock absorbing quality somewhat akin to that of a bag of meal that is struck a heavy blow; rebound is missing. The tire weighs approximately 30 per cent less than a solid rubber tire of the same size. Although developed primarily for commercial vehicles, the tire can be used on pleasure cars.

A Flat Band With Only One Surface and One Edge

By Carl Hering

SOME intellectual entertainment may be obtained by taking a strip of paper, say an inch wide and 8 or 10 inches long, and asking others to manipulate it in some way so that it will have only one surface and one edge. Originally it has two surfaces and four edges; by pasting the two ends together so as to produce an ordinary ring like a napkin ring, it will still have two surfaces, but now only two edges.

Although generally thought impossible at first, it is really quite simple. The solution consists in pasting the two ends together as though such a ring were to be formed, but first giving the strip a twist of half a turn. The former two surfaces and two edges will now form only one continuous surface and only one continuous edge.

Further entertainment may be obtained by cutting the ring in the direction of the length of the band, as though forming two narrower rings of it, and asking whether these two rings will be linked or unlinked. The guesses will generally be evenly divided, but both are wrong, as it forms only one ring of double the diameter. If the large ring thus formed is again cut in the same way, one might now expect it to double in size again, but it will surprise one again by this time forming two rings doubly interlinked. When the original is similarly cut into three parts it will form one small ring and one large one interlinked with it. By giving the original strip a whole twist instead of a half, it will have two surfaces and edges and will cut into two rings linked once. Three or five half twists again form a ring with but one surface and one edge, and will cut up into other though more complicated oddities, one of which is a single ring with a knot tied into itself, somewhat resembling a pretzel.

The single surface ring is also of interest as a mechanical and mathematical oddity. To show its true shape when it is formed according to a regular law, the writer had a model constructed. In its simplest form this law is, to consider the center line of the ring to be a circle, and the band is then described by a short line perpendicular to the circle and bisected by it, moving along the circle and at the same time turning or revolving around that part of the circle as an axis, so that when it has made its complete circuit of 360 degrees around the circle it has made a half turn around its axis, that is, 180 degrees, the two movements being, of course, perfectly regular, one degree of revolution for every two degrees of advance.

An ordinary strip or band of paper or metal made into such a ring as described above, will not take the shape of the regular form, as it would have to bend edgewise to do so, because one edge would have to be greatly stretched and the other greatly compressed. A paper or sheet metal ring will take an oval shape, in which the helical twist is mostly in one half and the cylindrical bend mostly in the other half.

The correct shape can be obtained only in a model free from any internal strains. Hence it was made of a tore or thick round ring of wood, of circular cross section, as shown in Fig 1. On the outside of this was then drawn the spirally shaped edge, and the part not wanted was cut away. The edge of the finished ring is therefore a part of the original surface of this tore. The band ring, thus formed, is shown in Fig. 2. Being made of wood, it had to be given considerable thickness for the sake of strength. Bands running lengthwise were painted on it in order to show its properties to better advantage. The white line at the center forms a circle (if the thickness is neglected), and if all the rest were cut away, this portion would form a circular ring whose solid part has a square cross section, and a twist of half a turn.

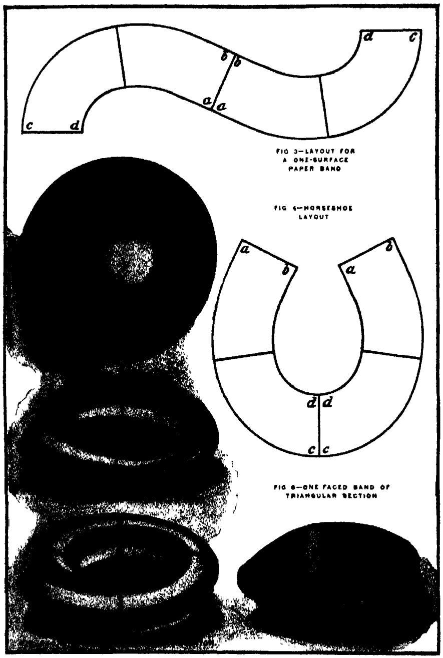
If a narrow strip of paper were laid on the surface of this white band, completely covering it, and had its beginning fastened to its end, it would when removed form a single ring of double the diameter of the original. If the same were done with the bands near the edge, two rings of double the diameter would result.

If the model were cut through between the white band and those near the edge, and supposing it were made of some flexible material, a large and a small ring interlinked with it, would be produced. When the width of the band is made greater, for the same center line diameter, the oddity of the shape becomes more pronounced. When the width equals the center line diameter the edge passes through the center where it is, for a very short distance, coincident with the axis. When the width is increased still more a peculiar reversal of curvature takes place. A limit to the width is reached when the edge touches the other side of the ring, that is, when the width is nearly twice the diameter, depending on the thickness of the band.

When revolved on its axis it produces a flow of air, hence acts as a noiseless fan as distinguished from those with blades which produce a succession of puffs. It also acts as a mixer for concrete or ice cream.

The peculiar surface of this ring occurs in nature in the conch shell, though somewhat imperfectly. A round rubber ring like an umbrella ring, when split in the direction of the planes of this single surface ring, will form a ring of double the diameter.

When such a ring is cast of a soft metal like lead, then cut in the plane of the axis, unrolled and untwisted, so as to form a flat strip, it has the shapes shown in Figs. 3 and 4, differing in where it is cut. Hence if a piece of sheet metal is cut to one of these shapes and then has its ends brought together, after giving it a half twist (*a* to *a*, *b* to *b*, etc.) it will approach the regular form. The horse-shoe template (Fig. 4) is perhaps the easier of the two to manipulate, as the curvature is then least at the joint.



c
d
a
a
b
b
d
c
FIG 3—LAYOUT FOR A ONE-SURFACE PAPER BAND
FIG 4—HORSESHOE LAYOUT
a
b
b
a
d
d
c
c
FIG 6—ONE FACED BAND OF TRIANGULAR SECTION

Some curious single-surfaced, single-edged bands.

A still more curious single surface ring is shown in Fig. 5. The cross section here is a square, as though made of a bar of square cross section, but instead of being given a half twist it is given only a quarter twist. At first sight it looks as though it should have four sides and four edges, but it has only one of each.

If cut lengthwise, dividing the square cross section into halves, it will be found necessary to cut twice around the circle, and it will then (if of flexible material) form one ring of four times the diameter and one quarter of the cross section. A round rubber ring can thus be split to form one four times as large. If the edge of the ring, Fig. 5, is cut off by a slanting cut, it will form a large ring while what remains will be a ring of the original diameter.

By making the section a regular hexagon, octagon, etc., and giving it a twist of one sixth, one eighth, etc., respectively, the ring will appear still more odd and deceiving, and if similarly cut, would form a ring six, eight, etc., times as large. The cross section of this form must of course be a regular polygon.

The one having a triangular section (Fig. 6) is of special interest, as there is a regularity or symmetry in its irregularity, and the twists may be made any multiple of one third. It cuts up into a variety of rings depending upon the direction of the cut.

When any of these rings, particularly those of the latter kind, are revolved around their axis, they will give a very good reproduction of the characteristic revolution of a vortex ring, more commonly represented by the usual smoke ring. This is made more evident by painting bands of different colors on them, like those on the models here shown.

The rings will then appear to be revolving around their circular center line as an axis, precisely as the vortex ring does. In fact, they then actually constitute a kind of vortex ring and ought therefore to have some of the properties of such rings, like rolling through air or water in the direction of their axis, or if this axis is at rest, then moving the air or water in the opposite direction, therefore acting as a propeller, though as an effective propeller it is subject to improvements in design.

The center of gravity seems to be at the center of the circular axis, hence such rings revolve smoothly. By securing to the ring a shaft in the line of the axis, a top may be made which when spun at a low speed will show the vortex ring motion quite nicely.

Fresh Discoveries Regarding Red Blood Corpuscles

SOME interesting observations on red blood corpuscles have been made by MM. von Liebermann and von Fillinger of Budapest, according to *Kosmos*, to the effect that many diseases which are not themselves, properly speaking, blood diseases, nevertheless produce injuries in these corpuscles, such injuries being observable in a salt solution, though not discernible under the microscope. They first made a suitable salt mixture in which the red corpuscles of a healthy man remained unaltered, one drop of the blood being placed in five cubic centimeters of the solution. This was verified with a number of healthy persons, and then tests were made with the blood of persons suffering from various diseases, among those mentioned being cancer, inflammation of the lungs, and inflammation of the breast. In all these cases the red blood corpuscles immediately dissolved, i. e., they gave up their red coloring matter to the solution. In other words, *hemolysis*, or dissolving of the blood, took place. The conclusion drawn is that probably in *all* diseases, and certainly in those named, the red blood corpuscles, though seeming quite sound when examined under the microscope, have in reality sustained alterations or injuries robbing them of their resisting power.

We must conceive that they have been poisoned by the virulent metabolic products which circulate in the blood of all diseased persons, and the fact that they were injured by such various diseases well illustrates the fact that the illness of any organ sympathetically affects the whole organism.

Another valuable observation was made in this connection. It was found that the injection of alcohol produced temporarily a similar effect on the red blood corpuscles. They were, in fact, poisoned by the alcohol for a time.

The Theory of Gravity

IN an extremely interesting paper on this subject in the *Philosophical Magazine*, Prof. McLaren considers the universe as possessing four dimensions, and also retains the notion of time. The universe so considered is regarded as changeless, but not timeless, and differs in this respect from Minkowski's four dimensional universe. Prof. McLaren considers that throughout the universe there is but one ultimate substance. This substance has, however, two forms, "matter" and "ether," which are exclusive one of the other. Matter is a region where the fluid grows or decays. This theory strongly resembles that proposed long ago by Bernard Riemann. Prof. McLaren pleads for an unprejudiced examination of these views, revolutionary as they are, in view of the widespread feeling that there is something amiss with the classical mechanical theories of matter.

The Lighthouse Reservations on the Great Lakes are able to grow all the white cedar needed for spar buoys in their district.

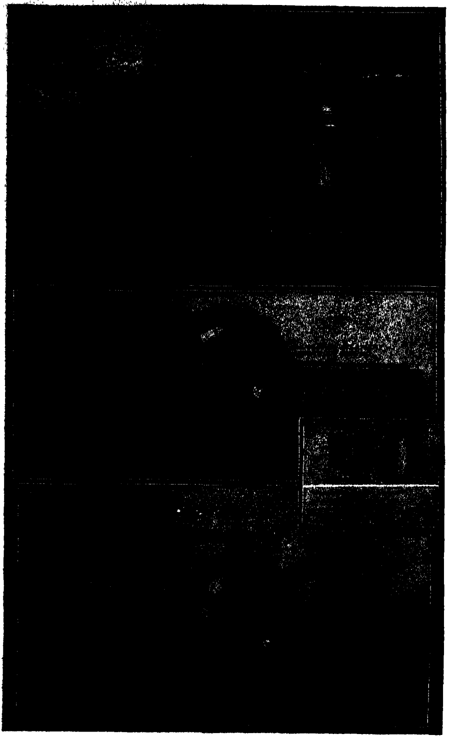
The U. S. Fleet Collier "Jupiter"

THE fleet collier "Jupiter" was authorized by Congress, May 13th, 1908; the keel was laid October 18th, 1911, and the ship went into commission April 7th, 1913. She was built in conformity with the rules of the American Bureau of Shipping. She is of twin-screw, single-deck type, and was designed for a speed of 14 knots with 5,500 shaft horse-power, on a draught of 27 feet 6 inches and a load displacement of 19,240 tons. She carries 11 officers and 148 men. The general dimensions of this large collier are: Length over all, 542 feet; beam, 65 feet; mean draught, 27 feet 6 inches.

She has four decks forward and five aft, the forecastle and poop each being one deck higher than the upper deck. Amidship in the cargo space there is but one deck. There are nine water-tight, five oil-tight and two non-water-tight athwartship bulkheads. There are thirteen cargo holds. Those that may be used for oil are in pairs, one on each side of the ship, and they are divided by a fore-and-aft bulkhead. The holes that are used for coal extend only the width of the ship and are of the self-trimming type. The coal-handling gear calls for a delivery of 100 tons per bucket, per hour, when the gear is operated by a winchman with one week's experience. The booms and the rigging are supported from towers, each consisting of two A-frames tied together with X-braces. There are seven of these towers in the waist of the ship and one on the superstructure. There is a single A-crane between the two after towers, which serves as an additional support for the fore-and-aft trolley ways which run between towers 6 and 8. At each tower except towers 1 and 8 there are four booms, two on each side of the tower. The thwartship cable span, which acts as a track for the trolley, runs from a boom head on one side of the ship to a boom head on the other side, and the cable span gives a travel of twenty feet beyond each side of the ship, and has sufficient height to clear the deck of a battleship twenty feet above the collier's deck. There are two winches, one clam-shell bucket of one ton capacity, and a trolley for each pair of booms. The hoisting engine is twin-cylinder with a 10-inch diameter and 12-inch stroke; it runs in one direction only, and has a throttle operated by a foot lever. The trolley engine is twin-cylinder with 8½-inch diameter and 10-inch stroke; it has reversing links for changing the direction of rotation, and this is operated by a hand lever; the throttle being operated by a foot lever. Each bucket requires two men to operate it, one man to open and close and hoist and lower and another to traverse.

For filling and emptying the cargo holds with oil there are four 6-inch gate valves on the forecastle and 6-inch wrought iron pipes which lead from these valves down through the forecastle, where two on each side join into an 8-inch pipe, and these two 8-inch pipes in turn connect to a 10-inch riser which leads down into the pump room. In the pump room are two 14-inch by 12-inch by 12-inch horizontal duplex pumps, rated at 1,000 gallons per minute each.

The main engines are of a new type, consisting of one Curtis turbo-generator, two induction motors, two water-cooled rheostats, and one main switchboard. The turbo-generator furnishes power for the motors, the function of the generators and motors being solely that of a reduction gear. All changes of speed are made by changing the speed of the turbine, thus varying the frequency of the generator, and consequently the speed of the motors. The speed reduction ratio is therefore 1 to 18. The object of this installation is to obtain the high efficiency of high-speed turbines and the high efficiency of low-speed propellers The weight of the installation is less than that of the standard type of ship drive, and the space also is less than in any of the present installations of marine turbines or reciprocating engines.



A most important advance in the development of the X-Ray is the invention of a new Roentgen tube by Dr. Coolidge. As a result of the invention the time of exposure is reduced to but a fraction of what it has hitherto been. The tube is so flexible that it can be operated at a penetration so slight as to show the fine blood vessels of the hand or foot at one instant, while at the next it can be increased so that a penetration far exceeding anything possible with the ordinary tube can be secured.

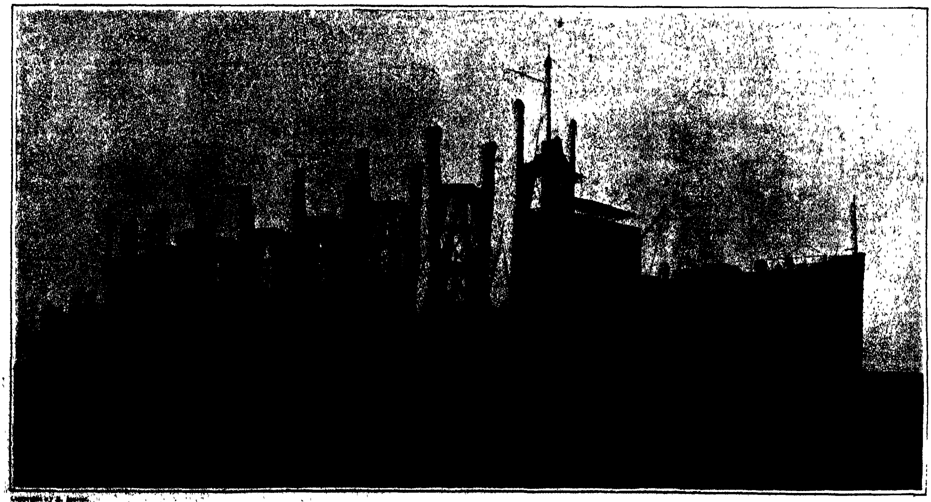
The new high efficiency Coolidge X-Ray tube.

The New Coolidge Roentgen Ray Tube

By Herbert T. Wade

IN using the Roentgen ray tubes the penetration of the rays has hitherto been controlled by regulating the vacuum of the tube, and, except for minor details of construction and methods for such regulation of vacuum, there has been little fundamental difference in the tubes used A new tube, however, designed by Dr. W. D. Coolidge, at the great research laboratories in Schenectady, has recently been developed in which an entirely new principle is involved. This tube gives a pure electron discharge and serves to reduce, in great measure, the actual time of exposure; in fact, it has been considered

(Continued on page 170)



Copyright by E. [illegible]

The new United States fleet collier "Jupiter" has thirteen cargo holds to be used both for oil and coal. She is distinguished by her peculiar booms and rigging, supported from towers each consisting of two A-frames tied together with K-braces,

Modern Hand-Grenades

The Aasen Hand, Rifle and Mine Grenade

By Major H. Bannerman-Phillips

THE use of the "grenade" in modern warfare is a revival of an ancient practice, and the term was first used by DuBilley in reference to the siege of Arles in 1536. Until the end of the seventeenth century soldiers of the line were trained to throw grenades by hand, hence the name "grenadier." The grenades were hollow balls of iron or other metal, or annealed glass, about 2½ inches in diameter, filled with gun-powder and fired by a fuse which was lighted before throwing them. Soldiers of long service and acknowledged bravery were selected for grenadiers, of whom there were comparatively few in each regiment of infantry at first, though later there were grenadier companies, and still later the "grenadier company" of each battalion took priority on parade in both the English and French armies, though they no longer carried the little spherical projectiles which first gave them their name, and were mainly distinguishable by the height of the men, and their special uniform or head-dress

Hand grenades were used to a large extent during the Russo-Japanese war, more particularly by both sides when fighting at close quarters during the assaults on the various forts at Port Arthur. The Japanese made them in the form of a small tin cylinder, about 8 inches long and 3 inches in diameter, filled with a high explosive and with about 7 inches of safety fuse projecting through a hole in the lid. This fuse being lighted before the grenade was thrown would allow about 9 seconds for the missile to reach its destination previous to exploding, but would not burn long enough to allow an enemy to pick it up when fallen and hurl it back before it had done its work. This was, in a manner, harking back to primitive methods, and any small closed tin receptacle would serve the same purpose if it were charged with gun-cotton or dynamite and a detonator and fuse attached in the usual way. The effect of these hand grenades when exploded in a confined space is sometimes very deadly. For instance, on one occasion a Russian guard of no less than seventeen men were killed inside a guard room by an improvised grenade, consisting of a fused slab of gun-cotton which was thrown through one of the windows.

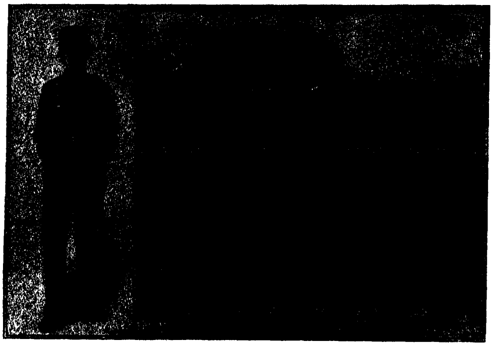
So effective is this class of projectile when used under suitable conditions such as by storming parties on siege works or in small sorties by the besieged with the object of attacking sap-heads and approaches, that the Japanese found it necessary, when working in the trenches close to the enemy's line, to protect themselves by special wooden frames about 7 feet by 4 feet with stout wire netting projecting above the parapet. It is not to be wondered at therefore if inventors have endeavored of late years to produce grenades which while deadly to the enemy on explosion shall yet be capable of being safely handled by the thrower. The Aasen hand, rifle, and mine grenades are constructed to meet these conditions, as will be seen from the following particulars furnished by the manufacturers. Our cover illustrates both the rifle and howitzer form of the Aasen grenade. Of the illustrations on this page, Fig 1 shows the manner in which a soldier carries hand grenades on his person; Fig. 2 is a picture of a volley of howitzer grenades, in which case the grenades are discharged from a fixed stand with various degrees of inclination to the horizon; and Fig 3 pictures several types of grenades In a recent number of the SCIENTIFIC AMERICAN, the Aasen mine grenade was described and illustrated—a bomb which is prevented from rising above a predetermined height by means of a chain secured in the ground, and electrically fired.

The methods and results of tests carried out with the various forms of weapon and projectile at a private practice range used by the inventor in Copenhagen in Denmark are shown as follows:

A. Volleys of rifle grenades were fired by 7 men from behind covers against a group of 80 double-figure targets of wood distributed under cover over an area of 900 square meters. Results of the first volley; as shown by numerals on the targets, 93 hits on 43 targets. After the third volley seventy-two targets showed 168 hits. The range varied between 300 and 400 meters.

The rifle grenade complete weighs about 550 grammes and contains 72 bullets each weighing 2.5 grammes and about 70 grammes of explosive. These 72 projectiles cover an area of at least 40 to 50 square meters. The rifle grenade can be used with an ordinary military rifle at all distances up to about 400 meters. The destructive efficiency of the grenade is due mainly to the fact that the interior percussion mechanism causes it to explode immediately on impact and before the grenade has time to bury itself in the ground.

B. Salvoes from seven "howitzers" were fired at a group of 80 figure targets placed within an area of about 900 square meters. The results of the first salvo are shown by numerals recording the hits on each target. After the fourth salvo 68 figure targets had received 143 hits between them. The distances varied between 280 and 310 meters. The grenades used were of type *C*, each weighing 1 kilogramme and containing 215 bullets and 200 grammes of explosive (Ecko). This *C* type can be thrown by hand up to 40 meters and with the "howitzer" or discharging tube up to 300 meters. The "howitzer" weighs 12 kilogrammes and can be carried in a special case as one would carry a rifle. The bullets cover an area of at least 80 square meters in the shape of a half-circle, and travel forward and sideways after the bursting of the grenade, but none are driven backward toward the thrower. These grenades are consequently of great value for fighting at close quarters. They are so constructed as to be secure from bursting until they have traveled at least 8 meters on their way toward the target.



1. Soldier equipped with hand grenades. 2. A volley of howitzer grenades. 3. Several types of grenades

Types of grenades to be use in modern warfare.

C. A single volley of 7 hand grenades, namely, 3 of type *A*1 and 4 of type *C*, thrown by hand from behind covers at the targets shown in sketch. Result: 119 hits on 33 targets as shown by the numerals on the latter. The hand grenade, type *A*1, weighs about 1 kilogramme, contains 190 bullets of 2.4 grammes each and a charge of 110 grammes of explosive (Ecko). The percussion mechanism and safety arrangements are similar to type *C*, but the bullets fly in *all* directions on the bursting of the grenade, consequently it is only suitable for throwing from behind cover.

D. Three mine grenades were buried underground in a triangle at 30 meters interval in the midst of a group of about 145 double-figure targets of wood, which were distributed over an area of about 2,700 square meters. The grenades were fired singly, one after the other (by electricity), and the results were about 700 hits among 120 targets, as shown by numerals.

The mine grenade weighs about 4 kilogrammes and contains 400 projectiles each weighing 3.8 grammes and 200 grammes of explosive (Ecko). The 400 projectiles cover a beaten zone of at least 800 square meters. The grenades are buried about half a meter underground, together with the electrical connections, so that they are absolutely invisible to an enemy. On being fired they rise about three fourths of a meter above ground before bursting and their projectiles are then driven in all directions parallel to the ground surface. At a distance of 10 meters they will pierce at least 100 millimeters of wood and will kill up to [illegible] meters. A hundred soldiers can lay out a protective line of these mine grenades 4,000 meters in length in less than two hours.

The Recent Earthquake

AT this writing, a few days after the earthquake of February 10th, it is impossible to present more than a fragmentary account of the occurrence, or to be sure that much of the information now available on the subject is accurate. Even if the disturbance had been far more severe, entailing immense loss of life and property, we should be in much the same state of uncertainty. As matters now stand in this country, it is nobody's business in particular to collect and digest reports of earthquakes immediately after their occurrence, when all the facts are fresh in the observers' minds, and a high degree of accuracy in the record is therefore attainable. Seismographs are in operation at a few widely scattered points, but there is no systematic and prompt interchange of their records, analogous to the process of assembling meteorological observations by telegraph which has been brought to such perfection by the Weather Bureau. In short, the United States Seismological Service is still only a dream; just as the national weather service was for the far-seeing American scientists of half a century ago.

The earthquake in question occurred a little after half-past one o'clock in the afternoon. The seismograph at the American Museum of Natural History, in New York, registered preliminary tremors beginning at 1:33:5; the first well marked shock at 1:33:25; the maximum at 1:33:45; and trailers continually until about 1:35. The macroseism lasted hardly half a minute. Shocks perceptible to the human senses occurred in eastern Pennsylvania, New Jersey, New York State, New England, and lower eastern Canada. The epicenter appears to have been somewhere in the lower St. Lawrence Valley. So far as may be gathered from press dispatches, it cannot have been very distant from western and northern New York, where the disturbance reached an intensity of 6, or possibly 7, on the Rossi-Forel scale. At Binghamton, Penn Yan, and Syracuse walls were cracked, unstable objects were thrown about, and a mild panic occurred among the inhabitants. In Manhattan very few people were conscious of the shock, but it was distinctly perceptible in parts of Brooklyn, owing evidently to local instability of the soil. After-shocks were reported from New England on the 11th.

The whole phenomenon was one which would have attracted little attention if it had occurred in one of the great seismic belts of the earth. Happily macroseisms are rare in the eastern United States; though the presence of extensive fault-lines running practically the whole length of the Appalachian Valley, and northward makes it certain that perceptible and perhaps locally destructive earthquakes will occur in this comparatively favored part of the world from time to time in the future as they have in the past. Their effects will depend upon surface texture. The same intensity of impulse that wrought serious disaster in Charleston, S. C., in 1886, would probably leave New York city unscathed; the former town being built on soft and largely "made" land; the latter on thoroughly consolidated soil and rock.

Mine Disasters in the United States.—The statistics of coal-mine fatalities in the United States during last August, just published by the Bureau of Mines, show 230 deaths, as compared with 211 during the same month of 1912. During the first eight months of 1913 the fatalities numbered 1,673, as compared with [illegible] during the corresponding period of 1912. These [illegible] figures emphasize the importance of the [illegible] and investigations in which the Bureau of Mines has taken the lead.

The Value of Radium

TO scientific men radium has been a subject of absorbing discussion from the moment it was discovered, but it is rapidly becoming a matter of considerable interest to the general public on account of its therapeutic value. Its extreme rarity and the mysterious and not yet wholly understood qualities and activities which are peculiar to it, added to the enormous difficulty in obtaining even small quantities of the precious metal, and the extraordinary prices quoted for it when obtained, invest the subject with a glamor which appeals to the romantic side of human nature. Consequently, every fact concerning radium, and every fresh development of our knowledge of its properties, are noted with intelligent curiosity by the great majority of newspaper readers, to whom chemistry is a closed book and physics a matter of no concern.

Its recent effects in the treatment of cancer have called forth manifestations of world-wide satisfaction, and "radium water" is now being tried for the treatment of gout and rheumatism. This is the ordinary fluid known to chemists as H_2O, and to the layman as simply "water," but it is charged with the emanation, or gas given off by radium in the form of radium salts. The method of preparation is to dissolve the salts in water, which is then sealed up and left for about 28 days, during which the emanation is produced. It can then be expelled by boiling and passed into another measure of water, endowing the latter with radio-active qualities. Unfortunately, this radio-activity only endures for a short time, and in 96 hours, or thereabout, the preparation has diminished in efficiency by more than fifty per cent. Water with a certain amount of inherent radio-activity can be obtained from springs, and dust with the same characteristics is also found in certain localities. In those cases the water must be drunk fresh from the spring, but the dust appears to retain its curative quality as a dressing for wounds or otherwise therapeutically, in the form of plasters and poultices, for a considerable time after removal from the spot where it is found and when it has been subjected to the influence of radium in the ordinary course of nature. In Great Britain, and presumably elsewhere, the usual course adopted in treatment of disease by radium water is to make up for the diminishing effect by increasing the quantity taken as the treatment proceeds, and as the water prepared thus is producible at a cost which is infinitesimal as compared with that of radium itself, it promises, if successful, to be a boon to suffering humanity.

It is to be hoped that as our knowledge of the effects of radium on cancer increases we may find some cheaper method of extracting it from the substances which contain it, for at present the cost of the process is simply prohibitive. So far it has been found in pitch-blende, autunite, carnotite and torbenite, owing to their containing small quantities of the metal uranium, which itself contains the much sought-for radium in the proportion of 1/3,000,000.

A ton of the ore above referred to will contain some ten milligrammes of radium and Madame Curie's standard sample contains twenty-two milligrammes of pure radium chloride. European transactions in this valuable product usually include an agreement providing that the article delivered shall be compared with the standard at Sèvres or the analogous standard at Vienna in the keeping of the Austrian Academy of Sciences.

The current market value of radium in Europe at the present moment works out at somewhere about $2,500,000 per ounce—not that any individual or corporate society is fortunate enough to be in possession of such a quantity.

How a Cream Separator Speed Indicator Saves Money

"THERE! If you've been turning your separator at that speed all the time, then with your twenty cows you've lost $524.10 worth of butter in one year!"

The above is the astounding statement made by a dairying authority to a farmer whom he had been watching operating his cream separator.

When you buy a cream separator you will find on the crank handle, in large, raised letters instructions something like this—"55 revolutions per minute." Or it may read 45, or 50, or 60; it varies on the different makes of separators.

Suppose, for example, that yours reads "55 revolutions per minute." What does that mean? It means, whenever you operate that cream separator you should turn the crank handle precisely 55 turns to the minute.

The manufacturer has tested his separator under every possible condition, in order to know the exact method of operation at which it gives the greatest degree of efficiency.

But how does the dairyman know how many times he turns it? It is just as impossible to guess accurately the speed of his cream separator as it is to guess accurately at other things.

At a Wisconsin dairy farm the superintendent said he always "guessed" the proper speed. When asked how his helpers operated the separator he replied that, after he had broken new men in, they also could operate it at approximately correct speed. In order to prove his statement, one of his helpers was asked to turn the separator at the speed he usually operated it. The number on the crank handle read "48 revolutions per minute." But the helper made only *28 turns* to the minute.

This proved how absolutely wrong the superintendent was in supposing that he, or any of his helpers, could tell when they were turning the crank handle exactly right, *or anywhere near*, what the manufacturer told them it should be turned. Here were pounds of butter-fat going to the hogs daily, just because he "guessed." And if he will feed calves and hogs with butter-fat worth 30 cents a pound, when he can feed them *better* on two and one half pounds of corn meal and skim milk, then that shows how much the dairymen have to learn to get all the profits out of dairying and farming.

At the Purdue Experiment Station, Indiana, very exhaustive tests were carried on to show the tremendous losses through wrong operation of cream separators. A separator was run at its normal speed of 55 turns to the crank handle per minute. Fifty pounds of milk were run through the separator. At this speed, it delivered 45 pounds of skim milk and 5 pounds of cream. This cream tested 2.11 pounds of butter-fat. When the speed was increased to 75 turns per minute, the skim milk discharged was 46½ pounds, reducing the cream to 3½ pounds. And the amount of butter-fat was slightly less than when the separator was turned at normal speed.

Next, a test was made by letting the speed of the machine drop down to that at which it has been found the average dairyman operates a cream separator, with the astonishing result that the discharge from the "cream" spout went up to 9½ pounds, but it tested *only 11 per cent of butter-fat—only* 1.04 pounds *of* fat out *of* 50 pounds of milk, as against 2.11 pounds when the separator was operated correctly.

Dairymen are losing *from* 20 *to* 50 per cent of *their* butter-fat with every operation. This is a matter of waste that is simply appalling when the aggregate figures of all the dairymen in this *country* are considered. It probably runs into thousands of dollars *with each daily milking.*

Now a speed indicator has been invented to be applied to cream separators, mounted on the crank shaft of the separator. As the separator handle is turned, the exact number of revolutions per minute that the crank handle is making is shown in a definite figure, so that it may be read at a glance. There is no calculating to be done; it is only necessary to keep on turning the crank handle until the proper speed is reached, and then continue at that exact speed throughout the separation. This eliminates all guess-work entirely. It also adds zest to the otherwise monotonous operation, particularly where the separation requires upward of an hour's turning, as its does in many instances.

Is the Earth Drying Up?

IN a recent paper before the Royal Geographical Society Prof. Gregory discusses this question. It is believed by many that there is a progressive world-wide change toward a greater and greater degree of dryness. Prof. Ellsworth Huntingdon believes that there are alternations of climate, it being sometimes drier, sometimes moister, but with a tendency to become generally dried. Mr. R. Thirlmere believes that the climatic changes take place in cycles, each cycle lasting 2,000 years or more, and that our world is at present cooling. From an exhaustive analysis of the evidence Prof. Gregory doubts the theory of a universal tendency toward drought, although there may be local variations. The strongest evidence for the desiccation theory is derived from Central Asia, the majority of travelers who have visited that region being convinced of its progressive change to a state of greater and greater dryness.

Absorption of Light in Space.—If one divides the known nebulæ in groups according to the dimensions of their apparent diameters and one also notes their intrinsic brightness, it is clear that their apparent diameters should decrease as the distance increases. Their brightness, on the other hand, will diminish with increasing distance only if interstellar space absorbs light. As the result of a great number of observations a correlation between brightness and apparent diameter has been observed, and is so marked that it is impossible to put it down to chance or to some systematic error. It appears that there is a real absorption in space, and if more precise descriptions of the nebulæ were available the law of absorption could be assigned. Another indication in the same direction is that the mean brightness of the nebulæ varies from one part of the heavens to another in a marked manner and in the same way as the stellar density.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

A Problem in United States Coins

To the Editor of the SCIENTIFIC AMERICAN:

Permit me to offer the following solution to the problem submitted by Theodore L. DeLand in the SCIENTIFIC AMERICAN of February 7th, on page 117, and entitled "A Problem in United States Coins." I have not yet thought of an algebraic formula by which the problem could be solved, but have reasoned it out by a process of elimination.

The highest common factor of 200, the number of coins, and 50,000, the value of those coins in cents, without making the resulting quotient approximately equal to or less than the number of different kinds of coins, which would be absurd, is 10. The resulting quotients are 20 (coins) and 5,000 (cents). Hence, if twenty coins can be found, subject to the condition stated, whose combined values are 5,000 cents, it will only be necessary to multiply the number and the value of each kind by 10 and add the resulting similar products to get 200 coins and $500 for the final result.

Considering only the four gold coins now minted, there are only ten possible combinations in which the values are less than 5,000 cents. If the number of coins in each combination be subtracted from 20 and their value from 5,000, it will be found that four of the possible ten combinations can be eliminated, because if all the coins in each case were fifty-cent pieces, the largest coin now left to be considered, their combined values would not be as large as the required value in the given combination. Therefore, only the following six possible combinations remain to be considered:

No. of coins.	Value in cents.	No. of coins.	Value in cents
15	250	14	500
15	500	13	500
15	750	13	250

By the same line of reasoning I took up each of the above combinations separately, and from the 15 to 250 one derived a 10 to 50 combination in which only dimes, nickels and cents had not yet been considered—4 dimes, 1 nickel and 5 cents make such a combination. Working back through the proper combination, I found that I had used 5 cents, 1 nickel, 4 tens, 2 quarters, 3 fifties, 1 ($2.50), 1 ($5), 2 ($10), and 1 ($20).

Multiplying by 10 as determined in the second paragraph above, I summed up as follows:

50 cents . .	$0.50
10 nickels	50
40 tens	4.00
20 quarters . . .	5.00
30 fifties . . .	15.00
10 ($2.50)	25.00
10 ($5)	50.00
20 ($10)	200.00
10 ($20)	200.00
200 coins	$500.00

Ithaca, N. Y. EDWARD D. ARNOLD,
Teacher of Physics.

Snow Rollers

To the Editor of the SCIENTIFIC AMERICAN:

About a year ago I wrote you concerning some "Snow Rollers" which had formed on our lawn at Potsdam, N. Y. The article was published and caused a little comment at the time. I thought it might be of interest that the "rollers" have again made their appearance, in the same place, though in smaller numbers. It is a curious fact that in no previous year has this phenomenon been observed here, and now it has appeared twice in succession. T. J. MOON.

Middletown, N. Y.

The Salving of Submarines

To the Editor of the SCIENTIFIC AMERICAN:

The daily press records the sinking of a submarine of the navy of Great Britain; and the fact that no provision is or has thus far been made for supplies while a boat is submerged, leads me to suggest the idea that comes to my mind in connection.

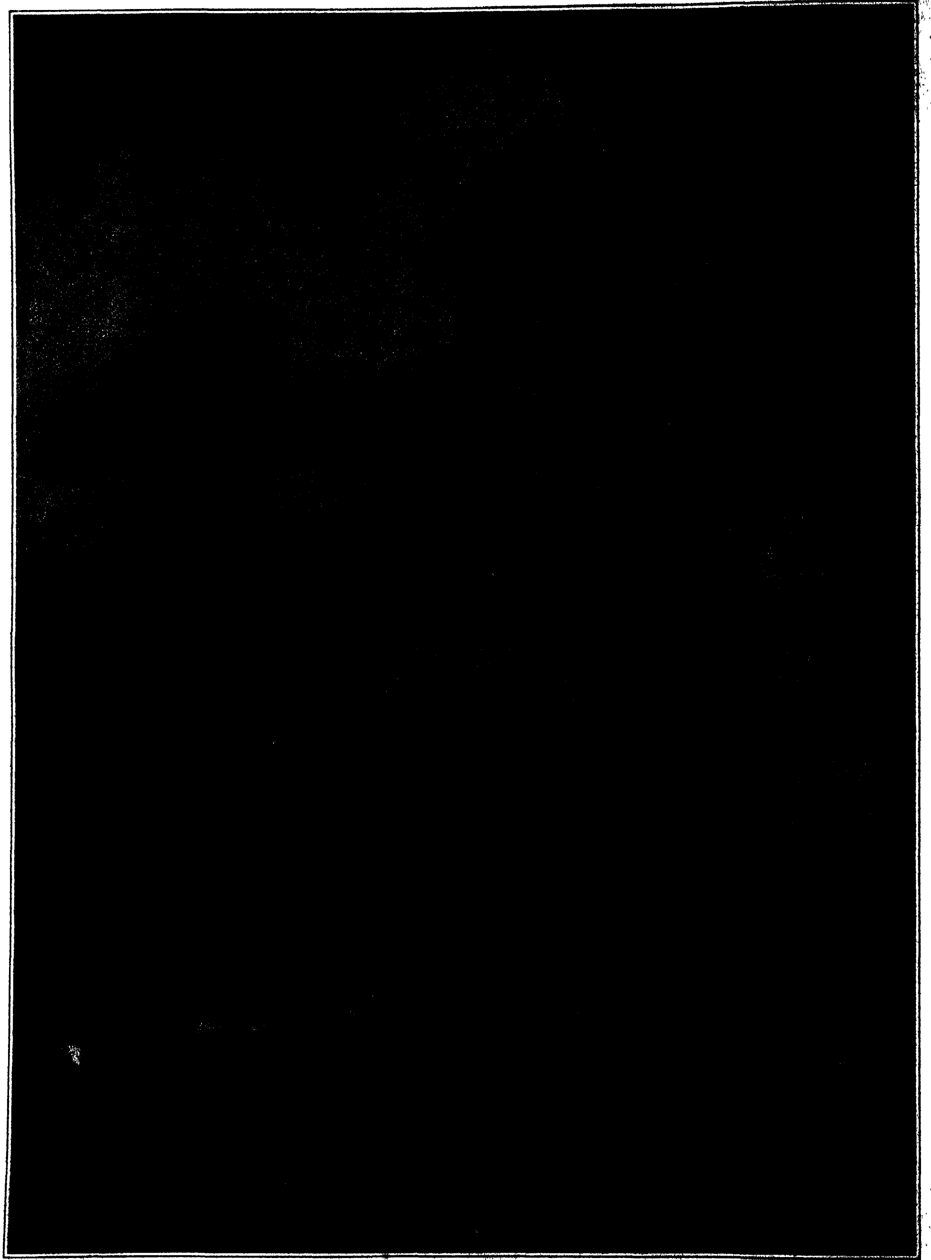
Were a length of hose contained in the submarine boat to pass through a hole in the top provided for the purpose, and the hose end connected with apparatus lighter than water, would it not be possible to—

1. Know the exact location of the submerged craft?
2. To keep the occupants imprisoned therein supplied with air and other necessities of life?

Then also if protruding hooks or bolts were fastened to the outside of the boat would it not be a provision that would tend to effect the raising of the structure submerged? ROLAND C. FINLEY.

Hamden, Conn.

Mr. Rodman Wanamaker of Philadelphia has decided to build a machine which will compete for the prize of $50,000 offered by Lord Northcliffe for the first crossing of the Atlantic Ocean in an aeroplane. The building of the machine will be intrusted to Mr. Glenn H. Curtiss, who has decided that the prize can be won in a flight of a single stage lasting not more than fifteen hours. The machine will have the general appearance here shown, and will be equipped with a motor of two hundred horse-power, which Mr. Curtiss is now testing.



General appearance of the Wanamaker-Curtiss biplane, in which an English and an American pilot will attempt to cross the Atlantic Ocean early during the present summer.

The Wanamaker-Curtiss Transatlantic Biplane

A VERY serious attempt is to be made during the season of the early summer to cross the Atlantic Ocean in a flying machine. Mr. Rodman Wanamaker of Philadelphia in a letter sent to the Aero Club of America, announces that he has commissioned Mr. Glenn H. Curtiss to construct a flying boat capable of making the trip across the Atlantic Ocean in a single flight of from twelve to fifteen hours.

So very little information has been given out as to the design of the aircraft in which this feat will be attempted that it is impossible to offer anything in the nature of critical comment. Mr. Curtiss has stated, however, that "for reasons not at all in accordance with those usually given for such a procedure a tractor screw in front of the machine will be used instead of the propeller usually seen in Curtiss flying boats." The hull will be of torpedo or streamline form of large diameter, almost entirely inclosed, so that in case of a forced "landing" in mid-ocean it can be relied upon to float for days. In the bow will be installed a motor of approximately 200 horse-power, readily accessible to the two operators. Twelve feet back of the motor will be the cockpit proper, and in it there will be room for the two men to sit down or move about. The controls will be in duplicate so that the machine may be handled by both men in unison, or by either one.

The wings will have a span of about eighty feet and the area of lifting surface will be about 1,200 square feet. The latest wings designed by Mr. Curtiss are able to rise from the water with a load of ten pounds to the square foot. Hence the actual lifting capacity of the Wanamaker transatlantic flying boat will be several tons, in other words sufficiently ample to provide for the enormous amount of fuel which must be carried. In outline the wings will be swept back at an angle of some six degrees. They will have a dihedral angle, rising from the center to the extremities to insure a certain amount of inherent stability.

Naturally everything hinges on the motor.

Up to the present time a 200 horse-power motor has not been mounted on a flying boat. To be sure Sikorsky has built four units of 100 horse-power each into his enormous machine. This, however, is not quite the same as concentrating 200 horse-power in the bow of a biplane. Even if the transatlantic flight proves a failure as a voyage, the experiment that Mr. Wanamaker is making deserves encouragement because for the first time light will be thrown upon the engine power required for large machines and on the behavior of very large engines in a regularly sustained flight.

The recent flight of Ingold, who covered a distance of about 1,000 miles in 16 hours, as well as the record flight of Victor Stöffler, who covered 1,340 miles in 24 hours, would seem to argue that given a perfect motor it is not utterly impossible to cross the Atlantic in 15 hours, in a single flight from dawn to dusk.

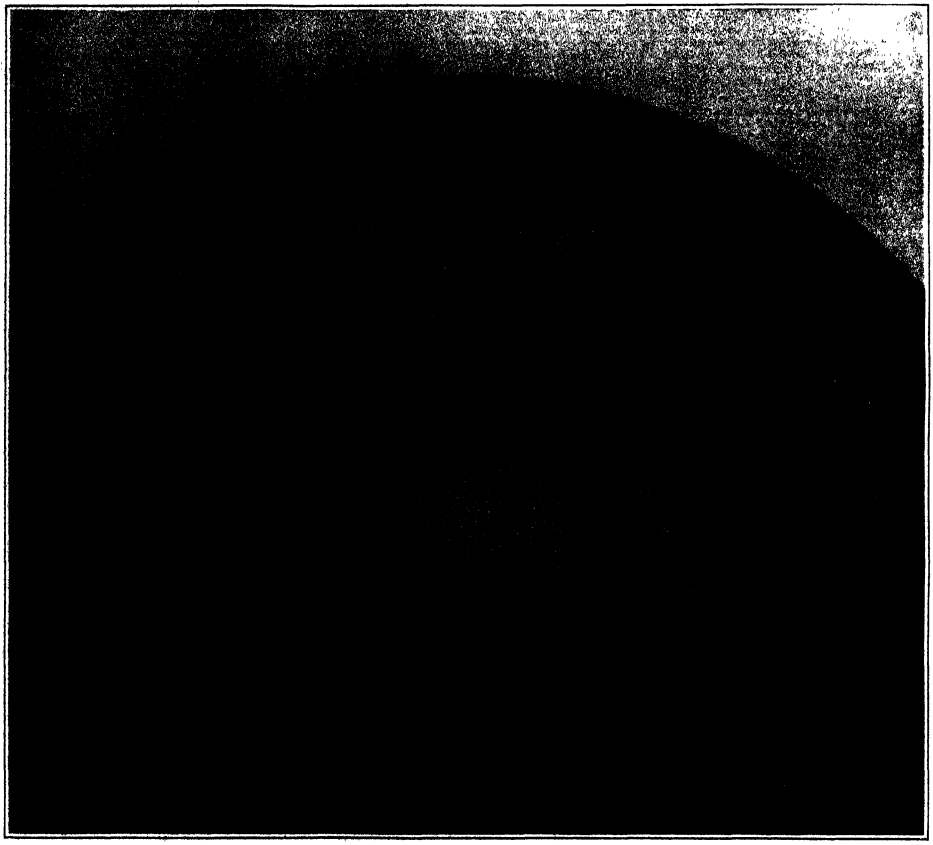
It may be questioned, however, whether Mr. Curtiss' expressed intention of having the machine fly at an altitude of 10,000 feet will be realized. The men who have made record altitudes testify to the difficulty of securing good motor compression at heights of 10,000 feet and over. Whatever may be the advantage to be gained by constant winds at that height, will be more than offset by imposing upon a brand new type of motor a difficulty with which even the tried engines of record breakers find it hard to cope.

Flying Around the World

THE ideal preliminary conditions of an aeroplane trip around the world such as the Panama Pacific Exposition authorities seek to encourage, include a thorough study of the portions of the proposed route not already aeronautically well known, the compilation of special maps and instructions, and, of course, the establishment of suitably equipped and provisioned landing places. It is passing strange that while the promoters of the race announce that a fund of $300,000 and possibly $500,000 (there is even talk of one million dollars) will be available for prizes, no provision appears to have been made for the equally important preliminary expenses of the undertaking.

It is impossible to estimate with any degree of accuracy what these preliminary expenses will be. Certainly there can be no haphazard start from San Francisco without a very careful plotting of the most desirable course. It may be that the aero clubs of the world will co-operate in mapping the routes for their own countries. But who will map out the routes over eastern Asia, the uninhabited islands that lie north of Japan, the bleak archipelago that spans the sea between Asia and North America, not to mention the all but unexplored wilderness in the heart of Alaska? The sum of $300,000 which has been set aside for prizes would in itself be hardly sufficient to meet the expenses of making the necessary preliminary explorations.

Consider also the necessity of landing places. How many shall there be? Assuming that the globe will be circumnavigated in stages of 600 miles there would have to be at least forty stations. By station we mean not merely a shed into which a machine can be run and housed for the night, but a depot for fuel and for the



One of the possible routes for circumnavigating the globe in a flying machine.

making of repairs. At least two men—skilled mechanics—must be assigned to each station. The cost of building the stations and of paying the salaries of the mechanics while they are on duty would amount easily to $1,500 for each station, in other words, $60,000. Add to this $50,000, the cost of building a machine strong and powerful enough to withstand the severe strain of such a tremendous trial (at least this much, it has been estimated, must be expended merely to cross the Atlantic) and the ambitious aviator must spend at least $410,000 in order to win a paltry $100,000 first prize

It is estimated that the distance which it would be necessary to cover would amount to about 22,000 miles. Assuming that the prize of $100,000 can be won, the successful aviator will have earned about $5 a mile. Mr. Grahame-White, whom Americans will remember as one of the participants in the Belmont Park meeting of 1910 as well as in flights at Boston in the same year and who, as many Americans can testify, knows how to charge for passenger flights, has stated in the press that his aviators at Hendon, England, are earning more than that per mile now

The time of ninety days allotted for the completion of the globe circuit seems extremely short in view of past performances. Vedrines consumed some weeks in accomplishing the 3,500-mile journey from Paris to the Pyramids Skillful aviator as he is, he flew on an average of only 100 miles a day. On the other hand, Brindejonc des Moulinais covered 3,002 miles in eight days in flying from Paris to Warsaw and St. Petersburg and back Vedrines' performance, however, is a more exact parallel to one of the stages in a globe circling flight He traveled over partly uncivilized countries, at great personal risk, whereas des Moulinais flew over civilized Europe after elaborate preparations had been made Yet successful as he was, Brindejonc des Moulinais is quoted as saying "The crossing of the Atlantic alone by any route or any system is impossible now, and probably will be for some time to come I doubt personally whether any pilot could stand the strain of a flight from Paris to New York even if he took his time about it"

In flying to Constantinople Vedrines was shot at by ignorant peasants. What would happen to an aviator who was compelled to land in the wilds of eastern Asia or on one of the sparsely populated Kurile Islands?

The art of aeronautical mapping has made much progress. The "international aeronautical chart," which will ultimately commensure the globe, is still in embryo, but plans for its construction have been matured by a committee of the International Aeronautic Federation. In the aeronautic charts of the Aero Club of France we already have an admirable model for the technical details of such publications. In the time available before the race it seems hardly possible to prepare special maps of the whole route. Where suitable *points de repère* do not already exist they must be erected.

Let us suppose, however, that the facilities at the command of the contestants, apart from the possession of larger aeroplanes and more powerful motors, and the presence of specially arranged landing and provisioning places at points where they are absolutely necessary, will not be superior to those enjoyed by Garros in his last trans-Mediterranean flight, or by Vedrines in his trip from Paris to Cairo What will be the special difficulties of a flight around the world? The mere distance—some 22,000 miles—is probably not one of them. In the last Michelin Cup contest Helen, a French pilot, made daily cross-country flights on 30 consecutive days, aggregating 10,000 miles. The conditions of this test forbade repairs to the motor or the renewal of any parts. Helen averaged 330 miles a day; but the "record" flight in 24 hours is Victor Stoffler's of 1,340 miles. These figures encourage the belief that the requirements of the 'round-the-world flight—22 000 miles to be made in 90 days—seem not unreasonable The race is planned for the months of May, June, and July At that season the contestants will enjoy the advantage of continuous daylight over a considerable part of their route North of about latitude 55 degrees there is no true night within a month or so of the summer solstice.

The length of the flights over water has been urged as the main difficulty. The longest lap of this character will be from southern Greenland to Iceland—say 670 miles With no fuss of preparation, and with a balky motor, Roland Garros recently flew 450 miles over the Mediterranean, from St Raphael to Bizerta Will not the aviators of 1914-15 better this record in the ordinary course of events?

So far we have ignored climatic and topographic conditions, and these we may now consider together. The question of temperature, in its effects on motors and men, is unimportant. It will be more a question of altitude than latitude in the coming contest, just as it is in the flights of everyday routine. An editorial on the race in the *New York Sun* probably reflects popular opinion in assuming that because Greenland and Iceland are included in the route the aviators will necessarily experience the rigors of a polar climate, but this is a fallacy. It is most misleading to compare Nansen's crossing of the Greenland ice-cap, as the editorial in question has done, with a momentary summer visit to Cape Farewell.

The general drift of the winds around the globe is decidedly favorable to the flight, which is to be from west to east, the direction of the great circumpolar whirl.

The journey from San Francisco across the American continent requires little comment. The aviators will naturally keep in touch with the Weather Bureau, in order to take advantage of the favorable and avoid the unfavorable, quadrants of cyclonic wind-systems. A crucial stage of the undertaking will be reached when the contestants set out from Belle Isle on the long flight to Greenland. Here the great—the almost insuperable—difficulty is fog. Statistics gathered at Belle Isle show an average of 10 days with fog in May, 17 in June, and 22 in July. Notwithstanding the fact that the notorious fogs of the Grand Banks lie to the south, the probability of foggy weather anywhere between Belle Isle and Cape Farewell during the summer months is very great. How this difficulty is to be solved, save by sheer luck, we are not prepared to suggest.

Ice is apt to be abundant off the coast of Cape Farewell, but the shore itself is free from ice and snow in summer and offers no serious obstacle to landing. The Eskimo population is extremely sparse, the nearest important settlement, Julianehaab, being 110 miles farther north. Presumably a regular landing station will be established at Cape Farewell, so that this consideration is unimportant.

The winds of the northern Atlantic Ocean are dominated by a quasi-permanent area of low barometric pressure—the so-called "Iceland low." The circulation around this "low," very active in winter, is comparatively sluggish in summer. The cyclonic storms which so frequently pass around the world from west to east in middle latitudes rarely run as far north as Greenland and Iceland, especially in summer. Local storms and squalls occur, but on the whole the wind conditions are not likely to prove a more dangerous feature of the Atlantic crossing than they would in a journey of similar length anywhere else in the world outside of the tropical and subtropical zones.

The next stage of the journey takes the aeronaut to Iceland. It fortunately happens that the west coast of Iceland is strikingly free from fog, owing to the fact that the ocean temperature in that region is always higher than the air temperature. At Stykkisholm there are only 6 days with fog in the year, on an average. On the eastern coast the conditions are reversed; Papey has 174 foggy days annually. Snow and ice rarely occur on the south and west coast in summers. The temperature sometimes rises at midday above 85 deg. Fahr., and the atmosphere is remarkably clear.

The next lap carries the aviator to the Hebrides and into the zone of occasional cyclonic storms. Fog occurs in the Hebrides one day in ten, and upward, during June. The journey through the British Isles to Paris, and thence to Berlin, Warsaw, St. Petersburg, and Moscow is all plain sailing—as aeroplane journeys go. The same may probably be said of the long stretch from Moscow to Vladivostok, where the trail is well blazed by the trans-Siberian Railway, and the climatic conditions are rather similar, except for somewhat cooler nights, to those that prevail in the interior of the United States in summer. The Urals and other mountains must be crossed, but such feats are now commonplace. The route is then across the sea to Korea, over the Japan Sea to Kobe, and thence northeastward by a truly formidable journey, *via* the Kurile Islands and Kamchatka, to Cape Deshenev (East Cape), and across Bering Strait to Alaska.

As soon as the Pacific seaboard of Asia is reached the aviator again encounters the fog problem, and this will haunt him more or less persistently until he reaches (if he ever does) the notoriously foggy bay of San Francisco. The entire coast of the Maritime Province of Siberia, including Kamchatka, is a region of dense and frequent fogs in summer, and the same is true of the Kurile Islands. Severe gales are said to be frequent in the Kuriles, but the fact is that very little is known about these islands, most of which have no permanent inhabitants and have never been explored. In Kamchatka the aviator has the alternatives of following a known coast-line, almost constantly shrouded in fog, or flying over a little-known interior, where there are no roads or settlements and a very sparse population of primitive inhabitants. The natural stopping-place in Kamchatka will be Petropavlovsk, the capital; a sleepy fur-trading village of 400 people. The region north of Kamchatka is even more desolate and forbidding. About the only saving grace of northeastern Asia from the aeronautical point of view is that the Russian government now maintains some powerful wireless telegraph stations in that quarter. All in all, the flight from Japan to Cape Deshenev appears to be the *crux* of the whole undertaking, and its feasibility in the present generation is certainly highly questionable.

A journey down the long Alaskan coast would again be attended by besetting fogs, varied with drenching rain-storms. These may, however, be avoided by flying well inland, where there are probably enough settlements and the country is sufficiently well mapped to make the trip feasible. The rest of the flight to San Francisco—after the stupendous feats that have gone before—may be taken for granted.

A $30,000 International Railroad Competition

UNDER a decree of the Ministry of Railroads, dated February 25th, 1913, the Chilean Government has called for an International Competition for Plans and Specifications for one central model workshop and four repair shops for the State Railways of Chile.

The bases of the contest are as follows:

1. A first prize of $20,000 for the best plan and a second prize of $10,000 for the next best. Honorary mentions will be awarded also. The money prizes shall be awarded only to plans for the central workshop.

2. The plans and specifications should be received at the Ministry of Railroads (Ministerio de Ferrocarriles, Santiago, Chile) not later than May 1st, 1914.

3. A Jury of Award composed of nine members appointed by the government and presided over by the Minister of Railroads, shall examine and pass upon the plans and specifications submitted, and report thereon within one month from the closing of the competition.

4. The prizes shall be paid within 30 days from the date of the jury's report.

5. The government of Chile reserves the right to reject any or all of the plans submitted, and consequently to withhold any or all of the prizes.

6. Plans and specifications to which prizes shall have been awarded shall become the property of the government, and all others are to be returned to their authors.

7. The fundamental requirements of the central workshop are as follows:

a. A capacity for repairing 500 locomotives with tenders per year, provided that no large repair work shall take more than from 60 to 90 days of eight and one half working hours. (An example of a large repair work would be the changing of cylinders and boilers, and their accessories.)

b. A capacity for the simultaneous and continuous repair of 50 passenger coaches and 400 freight cars.

(The present number of locomotives in operation is 600; of passenger cars, 500; and of freight cars, 6,000. These figures are to be increased yearly, as follows: Coaches and cars, 10 per cent; and locomotives, 5 per cent.)

c. It should be so equipped as to meet all the needs of the general service, its administrative organization, and the machinery and plants.

d. A capacity for producing not only the necessary pieces and parts, such as cylinders, boilers and mechanisms, but also such pieces as may be needed in the auxiliary repair shops.

e. Adequate stores for the stocking of reserve materials.

8. The central workshop may be presented in the plans as one plant to be built on a single site, or as two separate plants, one for locomotives and tenders, and the other for coaches and cars.

9. As to the auxiliary repair shops, their capacity or importance shall be determined by each competitor, taking as a basis the central workshop and bearing in mind the requirements of the service and traffic.

10. In drawing up these plans and specifications, the following facts should be taken into consideration;

a. That the necessary sites are to be furnished by the government without cost.

b. That native materials shall be used in so far as possible.

c. That prices of materials and machinery are to be estimated as placed on board at Valparaiso, and, therefore, not including customs duties.

d. That the State Railways will transport without charge all materials, but the cost of loading and unloading should be included in the estimates.

11. The government of Chile will furnish all available data and render all possible help for the drawing up of these plans and specifications, provided, however, that the competitor desiring such data or help shall have a duly authorized representative in Chile, who, on his behalf, shall express in writing his purpose to take part in the contest under these bases, and designate the persons who as experts are to undertake the studies in the country.

12. It is provided that this is exclusively a competition for plans and specifications, and that the government shall not incur any obligation as to the future construction of the works.

There are 36,500,000 young trees in the Government's forest nurseries.

An Organ on Which Color Compositions Are Played

The New Art of Color Music and Its Mechanism

By John W. N. Sullivan

In popular thought there is a well-marked line of demarcation between the Arts and the Sciences. But even a cursory examination reveals the fact that these two branches of human activity are in many cases closely connected. It is even true that some arts could not exist at all without the previous acquisition of a considerable body of scientific knowledge. The new art of kinematography is a case in point, and everyone is aware that the modern pianoforte is the result of a long development, a consequence of the increasing application of scientific principles to its construction. One of the most interesting examples of the reaction of Science upon Art is the new art of Color Music. In presenting this subject to the reader it is advisable to start with its analogy to Music, although, as we shall see, this analogy is not to be pushed to extremes. Both sound and color are vibratory phenomena, sound being due to vibrations of the air, and color to vibrations of the ether. Two notes of different pitch correspond to different rates of vibration, the higher note corresponding to a faster rate of vibration in such a way that doubling the rate of vibration raises the pitch of the note by an octave. The basis of the musical scale is the octave. Now if we examine light rays of different colors we should find that their rates of vibration are different. The light rays which correspond to the color violet are vibrating at almost twice the rate of the light rays corresponding to the color red. Color in light is analogous to pitch and sound. In the spectrum, which we obtain by decomposing white light by means of a prism, the colors range from red at one end to violet at the other, the intermediate colors corresponding to intermediate rates of vibration. It cannot fail to strike the reader that we have here a close analogy with the musical octave. On this basis we may found an explanation of the fact that certain combinations of colors are regarded as harmonious, whereas other combinations produce an intolerable sense of discord. So far we are on familiar ground. We are dealing with the statics of the subject, as it were. But while combinations of sounds are analogous to combinations of color, a musical composition is differentiated from a painting by the introduction of the time element. Music possesses the additional element of rhythm. It is Prof. Rimington's chief claim to distinction in this connection that he has imported this element also into color, thus giving rise to a new and beautiful art, the art of Mobile Color or Color Music.

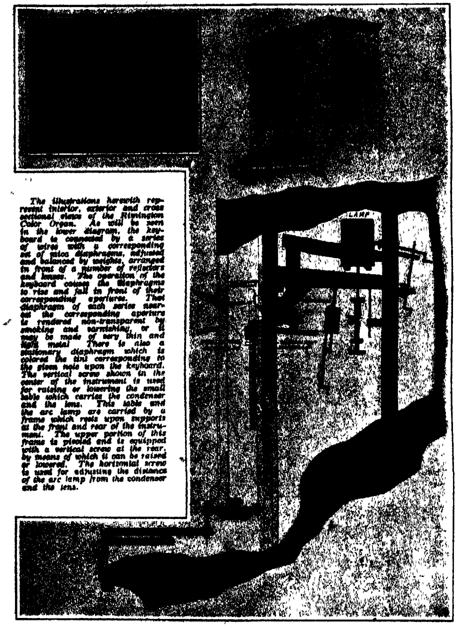
Rimington bases his work in this subject upon two indisputable psychological facts: Firstly, different successions of color, different color sequences, give rise to different sensations in the observer; and secondly, the rhythmic succession of these colors is of as much importance as the rhythmic succession of notes in a musical composition. Undoubtedly the best way of enabling the reader to realize the truth of these assertions would be to enable him to be present at the performance of a color composition; but as that is at present impossible, we must have recourse to describing a color composition in words. We cannot do better than quote from Prof. Rimington's book "Colour Music."

"Imagine a darkened concert-room. At one end there is a large screen of white drapery in folds surrounded with black and framed by two bands of pure white light. Upon this we will suppose, as an example of a simple colour composition, that there appears the faintest possible flush of rose colour, which very gradually fades away while we are enjoying its purity and subtlety of tint, and we return to darkness. Then, with an interval, it is repeated in three successive phases, the last of which is stronger and more prolonged.

"While it is still lingering upon the screen a rapid series of touches of pale lavender notes of colour begin to flit across it, gradually strengthening into deep violet. This again becomes shot with amethyst, and afterward, changing gradually into a broken tint of ruby, gives a return to the warmer tones of the opening passage.

"A delicate primrose now appears, and with little runs and flushes the pulsation leads through several passages of indescribable cinnamon colour to deep topaz. Then suddenly interweavings of strange green and peacock blue, with now and then a touch of pure white, make us seem to feel the tremulousness of the Mediterranean on a breezy day, and as the colour deepens there are harmonies of violet and blue-green which recall its waves under a Tramontana sky. More and more powerful they grow, and the eye revels in the depth and magnificence of the colour as the executant strikes chord after chord amongst the bass notes of the instrument.

"Then suddenly the screen is again dark, and there is only a rhythmic and echoing beat of the dying colour from time to time upon it. At last this disappears also, and there is another silent pause, then one hesitating tint of faded rose as at the opening of the composition.



The illustrations herewith represent interior, exterior and cross sectional views of the Rimington Color Organ. As will be seen in the lower diagram, the keyboard is connected by a series of wires with a corresponding set of mica diaphragms, adjusted and balanced by weights, arranged in front of a number of reflectors and lenses. The operation of the keyboard causes the diaphragms to rise and fall in front of their corresponding apertures. That diaphragm of each series nearest the corresponding aperture is rendered non-transparent by smoking and varnishing, or it may be made of very thin and light metal. There is also a stationary diaphragm which is colored the tint corresponding to the given note upon the keyboard. The vertical screw shown in the center of the instrument is used for raising or lowering the small table which carries the condenser and the lens. This table and the arc lamp are carried by a frame which rests upon supports at the front and rear of the instrument. The upper portion of this frame is pivoted and is equipped with a vertical screw at the rear, by means of which it can be raised or lowered. The horizontal screw is used for adjusting the distance of the arc lamp from the condenser and the lens.

Apparatus with which the "music" of color is produced.

"Upon this follows a stronger return of the colour, and as the screen once more begins to glow with note after note of red and scarlet, we are prepared for the rapid crescendo which finally leads up to a series of staccato and forte chords of pure crimson which almost startle us with the force of their colour before they die away into blackness."

This description may serve to show the imaginative reader that the new art is capable of producing considerable emotional effect. The possibility of the new art had occurred to several people before Prof. Rimington undertook his experiments, but it is a far cry from mere possibility to the actual perfecting of an instrument which should turn the possibility to an actuality. The apparatus which has transformed the art of color music from a dream to a reality is called by Prof. Rimington a "Color Organ," and consists essentially of three parts.

We have firstly, the source of light; secondly, the prisms and lenses for splitting the light into a spectrum; and thirdly, the mechanism which enables the performer to project given colors on the screen for a given time. One of the chief difficulties attending the construction of the instrument was found in securing efficient sources of light. Rimington employs naked arc lights, having a total candle power of about thirteen thousand. A well-known difficulty attending the construction of all arc lamps is to insure absolute steadiness of the arc. At one step in overcoming this difficulty, the Professor was led to invent a new form of carbon holder, which consists of a fireclay receptacle with three prongs, and has proved itself distinctly satisfactory. Nevertheless, a slight unsteadiness remains, and future experiments are going to be conducted with a metallic filament lamp. The mercury vapor lamp, in other respects very satisfactory, labors under the disadvantage that the red is almost entirely absent from its spectrum. The prisms are bi-sulphide of carbon prisms and the lenses are of the usual type. It is in the controlling mechanism that the resemblance to an ordinary sound organ becomes prominent. We have a keyboard which is exactly similar to the keyboard of an ordinary organ. Depressing a key enables a current of compressed air to reach the valve of a small motor, which motor in turn drags down a diaphragm, thus permitting light of a color dependent upon the key struck to flood the screen. Instead of one diaphragm a number of diaphragms are used, thus enabling the intensity of the projected color to be regulated. A complete spectrum corresponds to each octave on the keyboard, and the striking of the two notes of an octave simultaneously, for instance, removes two diaphragms from the path of the light. The diaphragms are each carefully colored to the precise shade of that part of the spectrum that they normally intercept. By a further device the whole keyboard may be made to correspond to the range of the spectrum, but this is chiefly useful in improvising. An ingenious modification has been the introduction of an auxiliary diaphragm of mica, crossed by lines which crowd closer together as they approach one side The light is therefore split up more at one side of the diaphragm than the other, and as the diaphragm is gradually removed from the light path, the light gradually grows in intensity. This prevents the light flooding the screen with disagreeable abruptness. The whole mechanism is really remarkably simple from the engineering point of view, although effects of considerable complexity can be produced by it. The compressed air is supplied by a bellows as in an ordinary organ.

Prof. Rimington is of the opinion that it is in combination with music that the new art will find its chief development. The close association of colors with sounds has always been noticed by musicians. In some works on music the writer has gone so far as to give a list of colors corresponding to the timbre of the various instruments in an orchestra To most people there is a distinct connection, which only requires to be pointed out. Thus Lavignac in his book "Music and Musicians," likens the timbre of an oboe to a rustic green, and the blast of a trombone to a heavy crimson. But this correspondence must not be made to assume an undue importance. While most people are agreed that certain instruments recall certain colors more vividly than others, there is no great unanimity of opinion respecting the colors chosen as belonging to certain instruments. But in its main lines the analogy holds good. Everyone would admit that a gradual fading from a bright to a dull color corresponds to a pathetic phrase in a musical composition. And vivid, striking colors do seem to correspond to the more vivid striking instruments of an orchestra. On this basis Prof. Rimington has devised color compositions illustrative of musical compositions, and the performance of the two together has been attended by the most satisfactory results. In writing a color composition musical terminology is employed, with the usual time markings and marks of expression. It appears that while most people find pleasure in a color composition done in slow time, rapid color passages require an educated eye. After a certain amount of training, however, rapid color passages are capable of furnishing a

(Concluded on page 170.)

A Million Shot Group

PROBABLY the first million shot group that has ever had its picture taken is shown herewith.

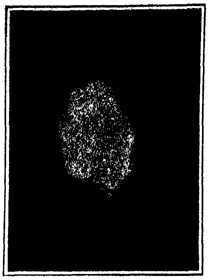
Speaking generally, most of us are content to regard a group of 10 hits, or may be two or three groups of 10 hits, as affording sufficient testimony of the accuracy or otherwise of a cartridge; it is something out of the ordinary therefore to get a single group of so many thousands of shots that if we call it a million we shall not be straining the truth overmuch

The illustration depicts such a group made with the 0.22 rim fire long rifle cartridge used in a target rifle at 100 yards

In the daily routine tests at a well known cartridge works in Bridgeport, a quantity of the cartridges are taken promiscuously from each loading machine every hour and mixed. Ten groups of 10 hits are then made from the machine rest at 100 yards, and these groups must conform to the required standard of accuracy or the batch is condemned The ten targets are mounted in a revolving frame which turns one tenth of a revolution for each shot and brings each target alternately in front of the gun and opposite precisely the same spot on the stop butt behind, consequently the group made on the stop butt is a composite of all the groups on all the targets.

Our illustration is from a photograph (five eighths actual size) of the piece of the stop butt behind the targets, which, though of ½-inch steel, is completely perforated and had recently to be replaced.

How closely the accuracy standard is maintained is clearly shown. The central hole, which oviously includes the majority of the hits, measures 2 inches by 1.4 inches —practically within the circumference of a silver dollar—while the thickly dented halo round it which embraces the remainder of the hits is just about 3 inches in diameter The tendency of the group toward an oblong shape clearly indicates the normal grouping


A hole that bears witness to accuracy in cartridges.

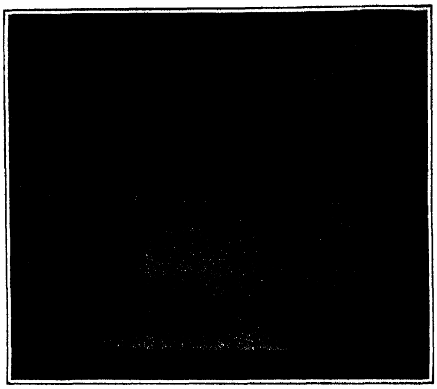
Curious Cloud Formation

WERE it not for the clew of the trees silhouetted against the sky, one would be apt to turn the accompanying picture upside down and regard it as a field of broken ice instead of an excellent example of *Cirro-cumulus* clouds or what is commonly known as "mackerel sky."

We are indebted to Mr. Frederick M. Smith, of La Mesa, California, for the photograph. He writes:

"On the 17th of September a cloud formation passed over this place which was of such peculiar appearance that it tempted me to make a record of it. The field of clouds spread over an area of perhaps two and one half miles square. I have seen at different times this same formation, but not so strikingly displayed as it was on this occasion."

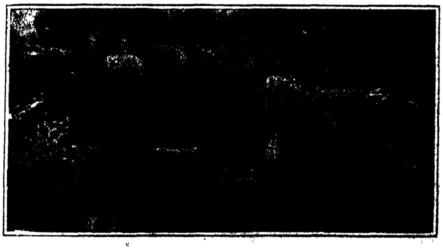
For the purpose of comparison we publish under the cloud picture a photograph of a field of ice The picture was taken in Toronto Bay. If strong sunlight were reflected from the ice, the resemblance would be much more striking


Curious "mackerel sky" formation that resembles a field of broken ice.

A field of ice in Toronto Bay. Compare with the picture above.

The Motor-car Express

A NOVEL form of passenger service is to be found in California A narrow gage railroad runs from Caldor to Diamond Springs, and to provide quick transportation over this line an automobile has been pressed into service The wheels have been removed and car wheels substituted The rear wheels are chain driven. The forward part of the vehicle is mounted on a four-wheel swivel truck. Of course the engineer or chauffeur does not attempt to steer the vehicle The automobile is a 1907 model, but apparently it is still in good running condition It is scheduled to make the round trip between Caldor and Diamond Springs (70 miles) in two hours and a half.


Motor car passenger service on a narrow gage railroad.

Motorcycle Electric Lighting Outfit

THE elimination of oil and acetylene gas lamps from motorcycles grows apace; manufacturers slowly but surely are turning to electricity as an illuminant, a fact which is amply reflected by the new machines that are being placed on the market against the new season. Among the various dynamo lighting systems which have appeared within a comparatively short time, the one which is illustrated herewith has a number of individual characteristics which make it interesting and which should make it appeal to those who incline to side-step all complicated mechanisms.

As the picture shows, the outfit consists of nothing more than a tiny little dynamo which is clamped to the front fork of the machine and driven by frictional contact with the tire, and a reflector containing an incandescent bulb.

The construction of the dynamo is unusual. The field consists of a large bell-shaped magnet of the permanent type to which the aluminium casing is attached. The armature shaft is carried in ball bearings, both of which are between the armature and the driving wheel. The armature winding consists of a sufficient number of turns of fine wire to insure the generation of six volts when the speed of the motorcycle becomes about 25 miles an hour. As there is no commutator, it is evident that the current is alternating and hence that a storage battery cannot be used with the generator. To provide a source of energy for the lamp when the motorcycle is not running a few cells of dry battery may be used.

In the electrical connections, one end of the armature winding is simply grounded to the armature shaft. The other end is connected to a wire gauze brush which bears against a button on the end of the armature shaft. But one wire is needed between the generator and the lamp, the ground connection serving for the return. The weight of the generator is only two pounds.

Motorcycle headlight and electric generator.

A Quick-acting Thermo-pile

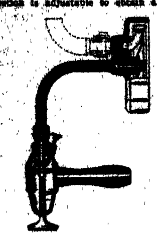
ORDINARY thermo-piles are rather slow-acting instruments. In their original form, as suggested by Melloni, they are made up of a number of metal rods joined in a batch, at the outer ends of which there are the two rows of soldered joints. On account of the great heat capacity of such a system, any increase in the temperature of the joints exposed to heat radiation is bound to last a long time, temperature equilibrium being reached very slowly.

In a paper recently read before the Amsterdam Academy of Sciences, J. H. Moll describes a new type of thermo-pile made up of a large number of small metal strips consisting partly of constantan and partly of copper, and which at their two outer ends are soldered to two copper terminals. The constantan-copper strips may be in their entirety exposed to the radiation, when on account of the very considerable difference in heat capacity of the two joints, the central joint is raised to a higher temperature than the outer one. However, mainly by reason of the excellent heat conduction between the two joints, these, after a very short time, will reach temperature equilibrium. Since the two metals have very different coefficients of heat conduction, their thickness and length should be chosen at such a ratio that during heat radiation the temperature in the central joint is highest.

Such elements are most readily combined into thermo-piles. One of those constructed by Moll comprises 80 elements which, arranged in 3 rows, filled up nearly completely a circle 2 centimeters in diameter and possess a total resistance of about 9 ohms. The sensitiveness and absence of inertia are strikingly shown by the fact that the light from a standard candle, at 1 millimeter's distance, will set up in it a thermo-force of 18 microvolts, the thermo-current reaching within 1¼ seconds, 99 per cent of its definite figure.

[illegible] particularly the design is for the [illegible] of a machine especially adapted for the [illegible] of [illegible] on [illegible] [illegible].

MASSAGE VIBRATOR.—G. A. [illegible], 67 Bay [illegible] St., Brooklyn, N. Y. This invention relates to a massage vibrator of that type in which the oscillatory element is driven from a motor through a flexible shaft, the motor being of the water turbine type. It provides an effective connection between the oscillatory element and rotary shaft of the device, which connection is adjustable to obtain a light or heavy vibratory action. By the provision of an improved mounting a rapid movement of the vibrator is insured. A form of motor of high efficiency is provided propelled by water taken from an ordinary city service pipe.



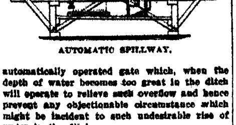
MASSAGE VIBRATOR.

STARTING AND STOPPING DEVICE FOR PHONOGRAPHS.—F. E. HARR, 612 W. King St., Martinsburg, W. Va. The purpose here is to provide a starting and stopping device for phonographs and such machines and arranged to enable the user of the machine to readily start the same and to permit of conveniently and quickly setting the device according to the record with a view to automatically stop the machine at the time the stylus reaches the end of the groove in the record.

GROOVING MACHINE.—J. J. MARSTALL, care of Marstall Furniture Co., Henderson, Ky. This improvement has reference to wood-working machines, and its object is to provide a new and improved machine more especially designed for simultaneously forming pairs of diverging grooves in two boards or other pieces of stock.

AUTOMATIC VENDING AND CHANGE MAKING MACHINE.—E. E. HENRY, 214 9th St., Astoria, Ore. This machine delivers merchandise, but is more particularly designed for a ticket-vending and money-changing machine in which coins of different denominations may be inserted, and change delivered to the value of the inserted coin, or in which coins or equivalent checks of varying value may be inserted and tickets and change be delivered to the value of the said coin or other check.

AUTOMATIC SPILLWAY.—C. SCHALLES, Cortez, Colo. The invention relates to artificial water courses, such as flumes, irrigation ditches or the like. Among the objects of the invention is to provide a ditch having an automatically operated gate which, when the depth of water becomes too great in the ditch will operate to relieve such overflow and hence prevent any objectionable circumstance which might be incident to such undesirable rise of water in the ditch.



AUTOMATIC SPILLWAY.

POST COLLAR FOR ROCK DRILLS.—R. NEWELL, care of J. F. Hambitzer, Houghton, Mich. This invention relates to the collars sometimes termed safety clamps, used on drill columns or posts below the drill, or below the column arm if the latter be employed. The object is to produce a collar which may be quickly and effectively adjusted in position and instantly loosened when required.

CONCRETE MIXING MACHINE.—R. L. CAIRNS, care of Speed Mach. Co., 70 Erie St., Passaic, N. J. The object here is to provide a machine of the revolving type which may be used as a "continuous type" so-called, for mixing the concrete in predetermined quantities, or in a continuous stream, as may be desired.

WASHING MACHINE.—P. W[illegible], care of H. [illegible], [illegible] W. 20th St., New York, N. Y. The invention provides a supporting frame for a machine readily adjustable to tubs of various sizes and shapes, provides a swinging frame which may be readily lifted out of the way when placing in or removing from the tub the clothes to be washed.

[illegible] MACHINE.—J. DeC. HALL, [illegible] [illegible]

[illegible] mechanical canceling, or indorsing of checks in banks or other institutions where the large amount of such work necessary entails considerable time when done by hand.

GEOGRAPHIC POSITION INDICATOR.—F. R. SWEENEY, 2183 15th St., Troy, N. Y. This improvement provides for automatically and at all times indicating the position in degrees of latitude and longitude of a moving body; provides a plurality of members, one thereof being maintained parallel to the earth's polar axis and the other of said members being maintained fixed in space without reference to the earth's surface; and provides the members mentioned with indices adapted to show the variation of the plumb levels at all points on the earth's surface.

MOTOR KNIFE GRINDER.—A. P. REDDEN, 10 Clifton St., Worcester, Mass. This improvement has reference to machines for grinding wood-working tools, and has particular reference to a machine adapted to be operated especially by electric motor, and is therefore portable so as to be moved in any suitable position in a work-shop or mill.

AIR PUMP LUBRICATOR.—G. M. SCHWEND, Birmingham, Alabama. Mr. Schwend's invention is an improvement in air pump lubricators, and has for its object the provision of mechanism for use with air pumps, wherein means is provided for throwing a charge of oil and water into the cylinder of the pump operated by the action of the pump.

Prime Movers and Their Accessories.

MULTIPLE POWER ENGINE.—W. S. WALKER, Lillydale, Monroe Co., W. Va. In this case use is made of high pressure cylinders, connected pistons in each pair of cylinders, steam chests for each pair of cylinders and connected by sets of admission and exhaust ports with the ends of the corresponding cylinders, valves in the said steam chests and controlling the ports, the exhaust motive agent from one end of a high pressure cylinder passing partly into the other end of the same cylinder and partly into one of the low pressure cylinders, and the exhaust motive agent in one low pressure cylinder being used expansively in the other, the pistons in the low pressure cylinders reciprocating at double the speed of those in the high pressure cylinders.

DAMPING TORSIONAL VIBRATIONS IN CRANK SHAFTS.—F. W. LANCHESTER, 53 Hagley Road, Edgbaston, Birmingham, England. The invention relates to high-speed reciprocating engines, and more especially to an improved method of and apparatus for eliminating certain forms of vibration in the running of high speed multicylinder engines, such as the four and six-cylinder internal combustion engines used for the propulsion of motor vehicles.

EXPLOSIVE ENGINE.—D. M. TULLOCH, 180 Pearl St., New York, N. Y. This invention more particularly is directed to an engine having an improved means of control of intake and exhaust. The principal design is to provide a mechanism for controlling the intake and exhaust of cylinder gases, the said mechanism being positively actuated by the reciprocating piston.

TEST OR PRIMING COCK.—B. MORGAN, Tews Court, Newport, R. I. The invention refers more particularly to a device which comprises a cylinder plug and a closing plug movably associated with the cylinder plug, the cylinder plug affording means for the introduction of an explosive fluid into the cylinder upon which the device is mounted, and having a valve-seat, the closing plug having a self-centering valve-seat-engaging part adapted to close the cylinder plug

Railways and Their Accessories.

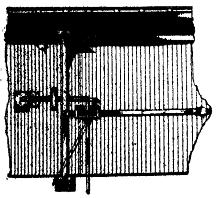
ADJUSTABLE TIE-PLATE.—J. ODIEN, 49 Ashton Place, Buffalo, N. Y. In the present patent the invention has reference to tie-plates for railways, and the object thereof is the provision of a strong and inexpensive plate which will accommodate rails of different sizes and which will prevent lateral movement of the rails positioned thereon.

RAILWAY SWITCH.—J. W. HUBBARD, Eau Claire, Wis. The purpose here is to provide a construction of locking device for railway switches which will operate more readily and advantageously than the apparatus set forth in this inventor's application for a patent, Serial Number 660,257, and to this end he provides his improvements with suitable antifrictional braces to engage the side of a draw bar and afford the desired results.

SELF LOCKING SPIKE.—G. I. DE FORCE and MOSES [illegible]. Address the latter, 506 State St., Erie, Pa. This invention comprehends a spike having all the advantages of an ordinary spike, and at the same time provided with shoulders of peculiar form for preventing the ready withdrawal of the spike from the wooden cross tie or other analogous member into which the spike is driven.

CAR COUPLING.—[illegible] L. ROBERTS and [illegible] L. [illegible], [illegible] W. Front Ave., Ashland, Ky. This invention relates to railway draft appliances and has particular reference to car couplers of the Janney type. The improvement provides for a number of structural features of advantage in the detachable yoke member constituting the main part of the device, whereby the same is strengthened and otherwise made more suitable in practice.

CAR DOOR OPENER.—J. W. CARVER, Hay Springs, Neb. The invention relates to an apparatus adapted to be installed on grain or box cars for affording convenient means for opening and closing the slide door of such cars. The invention provides a stationary frame applied to the body of the box car and including a track along which moves a carriage that is operatively connected with the doors, said carriage being moved step by step in one direction by a novel mechanism to open the door and in the opposite direction to close it.

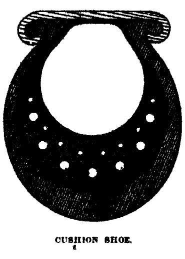


CAR DOOR OPENER.

MACHINE FOR GROOVING RAILWAY SLEEPERS.—A. PANKL, Kommanditgesellschaft Guido Rütgers, Vienna, Austria-Hungary. In machines for cutting into the upper surface of the sleeper receiving the tie plate, the ends of the sleeper are yieldingly pressed against fixed guide rails near the rotary cutters and then pushed past the latter, whereby such grooves of desired width are cut in the predetermined position and whatever may be the thickness of the blank or its transverse sectional shape. But if the upper surface of the raw sleeper is not plane for any reason, then the groove may become too deep or too shallow, the sleeper is either too much weakened by the groove or the groove is too shallow for the purpose. The inventor overcomes this difficulty.

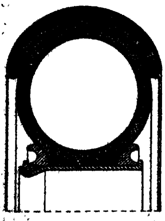
Pertaining to Vehicles.

SHOE.—R. D. S BENNETT, 514 West Mt. Vernon St., Springfield, Mo. This invention relates to tires and parts associated therewith, the more particular purpose being to provide an *improved form of cushion shoe forming* practically a part of the tire and adapted for maintaining the firmness thereof while permitting a considerable degree of resilience in the tire. It further relates to improvements in shoes or cushions forming parts of tires and carried thereby for the purpose of increasing the general efficiency of such structures.



CUSHION SHOE.

PNEUMATIC PUNCTURE PROOF TIRE.—F. NEWBAUER, Valley City, N. D. In this patent the invention relates to pneumatic tires for use on automobiles, and includes a novel, detachable, puncture proof tread, as well as a tire extending continuously in closed form at the inner side, whereby the inner tube is effectively protected against possible damage by defective wheel rims. The accompanying engraving shows in cross section a tire embodying the invention.



PNEUMATIC PUNCTURE PROOF TIRE.

AUTOMOBILE SLEIGH.—W. J. WRIGHT and R. H. HOCKIN, Oak Lake, Manitoba, Canada. This attachment is for use in connection with automobiles and other motor vehicles for the purpose of propelling such vehicles through the snow and it comprises an arrangement of parts upon which the body of an automobile or other motor vehicle can be easily and readily mounted when road conditions are such as to make the ordinary apparatus of the motor vehicles of little or no utility

VEHICLE STEERING DEVICE—F. S HARRIS, Waverly, Ill For the purpose of this invention, use is made of brackets attached to the axle and steering rod members pivoted on the brackets and having a sliding connection with each other, and a single spring engaged at its ends by the said members to compress the spring on shifting the steering rod sidewise in either direction

SNOW PLOW—W L. STADIG, Soldier Pond, Maine An object here is to provide a machine so mounted on sleds as to accommodate itself to uneven roads; to provide for convenient adjustment of the snow removing devices to the end that a wider or narrower way may be cleared, and the snow removed to produce an essentially level way, or to leave a ridge or cone at the center.

VEHICLE WHEEL.—G R. WILLIAMS, 620 Empire Bldg., Atlanta, Ga The invention relates to resilient wheels, and provides a structure presenting advantages over what is described and claimed in Letters Patent No 921,498 granted to Mr. Williams. The principal object of the present patent is to provide a wheel, characterised by an arrangement of parts in which the spokes of the wheel are in a condition of initial stress.

VEHICLE FENDER—G. HIPWOOD and P. EGAN, 39 Cortland St., New York, N Y This invention provides an apparatus adapted to operate in dual capacity, as a buffer and a fender; provides means for causing the apparatus to automatically assume a position to operate in the latter capacity, and provides means manually operative for disposing the mechanism in position to operate in either of the capacities mentioned, and if desired without necessitating the chauffeur or driver leaving the vehicle.

SHOCK ABSORBER.—J M. JACKSON, Parkersburg, W. Va The invention refers to shock absorbers for vehicles, and the primary object is to provide an arrangement in which, under normal road conditions, there is no engagement of any parts and therefore no noise and no necessity for lubrication

SPRING WHEEL—D. A. GRAY, Chattanooga, Tenn. An object of this inventor is to provide a device which will have the advantages of a pneumatic tire, but which will not subject the owner of the vehicle to the delays incident to punctures and blow-outs such as occur with pneumatic tires.

Designs.

DESIGN FOR A CRACKER OR LIKE ARTICLE—H HANDY, 240 W 104th St, New York, N. Y. In this ornamental design for a cracker or like article, the design shows a figure of a man of the old peasant type in a characteristic and picturesque posture.

CARPET OR RUG—J F DU BOIS, Springfield, Mass, care of G S. Squire, 25 Madison Ave., New York, N Y In this design for carpet or rug the fine effect is produced by an ornamental border inclosing a field of closely clustered figures without a centerpiece

DESIGN FOR RUBBER MAT BINDING.—F. H TIMKE, care of John Kroder and Henry Reubel Co., 107 E 17th St., New York, N. Y This design for rubber mat binding shows a binding of very simple, but attractive features of ornamentation.

DESIGN FOR A BATHING CAP.—R PARKER, care of Parker, Stearns & Co., 300 Sheffield Ave, Brooklyn, N Y The first figure in this ornamental design shows a perspective view of a bathing cap, the adjusting ribbon being shown in an untied fashion, while the second is similar to the first, but showing the ribbon drawn and tied.

DESIGN FOR A WINDOW DISPLAY.—C E. ISACKE, 96 Fifth Ave, Manhattan, N Y, N Y In this ornamental design for a window display the figure shows a front perspective view of an attractive structure.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

WE wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialised, technical, or scientific knowledge required therefor.

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Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12935) E. R. R. asks: If a passenger train of all-steel cars and running in the electric zone should be derailed and make contact with the third rail or the overhead wire should be torn down and come in contact with the cars, what effect would it have on the passengers? Is there a chance that in such an accident, the loss of life would be greater than any we have had with wooden cars or when heated by stoves? A We do not think that the injury to passengers in a steel car would be any greater upon derailment, or other contact between the car and the third rail or trolley wire, than with a wooden car, if as great The current would find an easy path over the exterior of the car to earth, and unless in some unusual circumstances should not enter the interior of the car at all The bodies of the passengers would present so high a resistance that no injury should ordinarily result. Doubtless many nervous people would suffer from shock in such a case, but the shock would not be electric However, no one can prophesy with any positiveness about this matter Each case would have its own peculiar conditions and results

(12936) H. C. K. asks: 1. Is there any truth in the disputed arguments among mechanics and engineers that a long screw driver will drive a screw easier than a short one if the handles are exactly the same? A All mechanics find it easier to drive a screw with a long screw driver, or think they do. It is quite possible that the long handle is more easily kept in a right line with the screw, and thus aids in the work We do not think the discussion a very important one. 2. Does it change the location of the poles on the surface of the earth if you change the inclination of the axis of the earth? A The axis of the earth is all the time moving in the earth, and the latitude of places is changing a very little This you will find in Todd's "New Astronomy," which we send for $1 45 postpaid

(12937) Mr. N. R. Crawford sends us the following formula for sugar-curing of meat, and we take pleasure in giving our readers the benefit of this advice: For 1,000 pounds of pork, take 30 pounds of pulverized salt, 5 pounds sugar, 1 pound black pepper, pulverized, and 1 ounce of saltpeter. Mix the above together. While the pork is hot, cut it up and rub the mixture thoroughly over the meat, rubbing it in all crevices. Lay it on a table or shelf and leave three days, after which go over and resalt again as the first time In three days more go over it the third time Allow it to stay spread about one week or ten days, and hang it up and smoke it. The above amount of salt, sugar and pepper will be sufficient to salt the 1,000 pounds the three times. The quality of the meat will be much improved over the old method The first application must be applied while the animal heat is in the meat

(12938) G. A. C. writes, referring to Query 12879, that we may possibly see a distant star by the light which is reflected from the surface of the earth *to our eyes* and *thus increased* much above what the star can send in a direct line to the eye, also that we see an object when we look at it by some power of the eye by which we do not have to wait for the light to come to us, but see instantly by the act of turning our eyes in the direction of the object, that thus a "tele-microscope" might be invented which would not simply penetrate space instantly, but disclose minute structures instantly in the most remote regions of space. We are not able to agree with this explanation of the mode in which we see a distant heavenly body, and may briefly point out the differences in our view of the matter. 1 It does not seem possible that we see a heavenly body by light which has been reflected from the earth, since we should then see the light coming up to us from the earth, and not down from the sky We see an object in the last direction followed by the light from that body as it enters the eye 2 Nor do we see an event in our field of vision at the instant it occurs, but only after the light which communicates the knowledge of the event to us has traversed the space between our eye and the place where the event occurred Prof Simon Newcomb set a mirror at Fort Meyer and sent light from the foot of the Washington Monument to Fort Meyer on the other side of the Potomac, and measured the time which the light required to go over that space and return This is described fully in our Supplement No 557, price ten cents. This being the case, Prof. Newcomb could not have seen the light till it had traveled over that space twice It would have been the same if he had sent his light to the moon and back, or to a remote star 3 There is an error in most people's minds as to what is meant by looking at anything. Some people seem to think that we do something with the eyes in looking Nothing of the sort To look at a thing simply means that we turn the eye so that light from that thing can enter it and thus enable us to see what that light can convey to the mind We see what was happening there when the light left its source. 4 The idea of a "tele-microscope" is very old In the early days of the New York *Herald* it published the famous "Lunar Hoax," which was that a combination of a microscope and telescope had been made in England so that the image of the moon could be studied and the minutest details of its surface and inhabitants could be seen. It is not necessary to say that the hoax was short lived. The arrival of the first vessel from England exploded the story and revealed the hoax. No telescope can reveal minute details or annihilate space and time. In darting glances at some near object there is nothing sent from the eyes of the darter to the near object, unless it be an electric shock, or magnetic impulse, and these require time to travel.

(12939) D. L. M. asks: From the time of my childhood up to the present time I have heard the statement made and reiterated many, many times, that the earth is constantly cooling, and that the time will come when the earth will be a frozen body. Last Summer I heard a minister make the statement in a sermon. At once my mind nailed the absurdity (if it be such), for thermal or heat rays will not pass through a vacuum, but, on the other hand, we know that light rays readily do. Now from this you can readily see that the heat coming to us from the sun in the form of light rays is at once absorbed and converted into thermal rays, and these latter cannot pass beyond the air. Certainly there remains to be proven that there is a vacuum beyond the air But from the fact that meteors are not heated until striking the air, we are of the opinion that beyond the air there is an absolute vacuum. This theory leads us to the contrary of the old theory The earth is getting warmer and warmer I am unable to see the flaw in this reasoning, if there is, I should be glad to know it. A We regret that we do not find ourselves able to agree with your argument regarding the heating of the earth. The statement that heat rays will not pass through a vacuum contradicts common experience. The bulb of an incandescent lamp contains a high vacuum. It cools off after the current ceases to flow, and in a very short time is at the temperature of the surrounding air. The heat of the sun comes through space. It is a vacuum. Again, heat and light are the same energy, and not as you seem to think, totally different things. The rays which enter the eye become light If they struck the hand they would be heat. Light and heat are both electromagnetic effects. The earth is continually radiating heat into external space. This is also a matter of common experience. The earth cools every night, and every winter still more so that ice forms over the water and in the ground. This could not be unless the earth loses the heat which in the daytime and the Summer has been given to it by the sun. Finally, the facts are against the hypothesis that the earth is growing warmer year by year. Vegetation has not changed in historical times. Italy has the same grape and olive harvests as in the days of Horace. For over two thousand years the climate of Europe has not altered sensibly. If the earth were growing warmer, this period is surely long enough to show a change of the line of growth of delicate crops, which would now grow farther north than they did in the classical period. Scientists hold that the earth radiates into external space all the heat which it receives from the sun, so that the average temperature remains the same year by year, or at least that the change is not perceptible in a relatively short time. It is also believed that the sun itself must ultimately reach a condition in which it will be unable to furnish its present supply of energy to the earth, and that then the loss of heat from the earth will exceed the supply received from the sun Then will come the end of life on the earth unless the order of things changes

(12940) L. G. B. asks: 1. It appears that the capacity for heat of the metals is low, that of water is high, that of hydrogen is still higher. What is the capacity for heat of a vacuum? A. The capacity of a vacuum for heat is infinite, which means that heat cannot be communicated to a space which is absolutely empty of ordinary matter. The radiation from the sun passes through space to the earth and the other planets without warming the space through which it passes. It will warm any matter which it may strike. 2. When gas is permitted to expand into a vacuum, there is an evolution of heat from the vessel, is there not? Doesn't that show that the vacuum contained heat which the gas drove out? A. So long as gas is expanding there cannot be any heating action from the gas. When a gas is driving other gas before it and compressing that gas, it is doing work upon something, and heat will be produced in the doing of that work. There would be no evolution of heat from the containing vessel at any time, if we correctly understand the use of that word in your inquiry. We mean that there would be no heat given off from the vessel itself which had not been communicated to it from some other source. If any heat was given off by the vessel which did not come from the compressing of the gas, that heat would leave the vessel colder, and must be accounted for in some other way; as, for instance, coming from the vessel because it was hotter than its surroundings, since heat cannot pass of itself from a colder to a hotter place.

NEW BOOKS, ETC.

Standard Organ Building. By William Horatio Clarke. Boston: Richard G. Badger, 1913. 8vo.; 219 pp. Price, $2 net.

"Standard Organ Building" is presented as a text-book to guide church officers and organists in selecting an organ. The average organist may also use it as a reference book to familiarize himself with the mechanical side of his instrument. The mechanical and musical features embodied in good organ building practice are plainly indicated, and the point of view is always distinctly and exclusively practical and modern—only the present development of the organ is dealt with. The author is a well-known organist and a writer of music and musical literature. It is not so generally known that he was for some time proprietor of a large pipe organ factory. Here he determined the complex essentials of the best modern organs, and it is this knowledge—or such part of it as church authorities may find useful—that he imparts through this well-printed and well-arranged volume.

Food and Flavor. A Gastronomic Guide to Health and Good Living. By Henry T. Finck. New York: The Century Company, 1913. 8vo.; 594 pp.; illustrated. Price, $2 net.

Mr. Finck is an epicure. He would have his cook put through years of apprenticeship, as the French do. His gastronomic guide must be judged from the epicurean point of view. To the low-diet enthusiast it is anathema. Its descriptions of native and foreign dishes would ruin the resolves of a St. Anthony But the work has an aim more worthy than that of making the mouth water. It preaches the gospel that flavor is the soul of food, a fact shamefully ignored The psychic factor of desire must precede ingestion, or results will be unpropitious. To each cent spent for nutriment we add five more for flavor Flavor, in short, has an appetizing value, a health value, a commercial value. The evolution of a discriminating appetite and the education of the cook must go hand in hand But your glutton is never an epicure. Rational mastication must accompany the highest enjoyment of food, and in this enjoyment lies perfect assimilation and health It is flavor that stimulates the flow of the digestive juices; it is the digestive juices that prepare the food for the extraction of nutriment. America's hit-or-miss methods of selection and preparation are sharply arraigned, and the blame is to some degree apportioned. Sensual indulgence is held to be a duty. But the mouth must do its share, or the digestive tract has to do it at ten times the expenditure of vital force, and dyspepsia results Taste is limited to the qualities of sweet, sour, salt and bitter. The infinite variations of palatable sensation are to be credited to the sense of smell in combination with these elementary flavors. "Our Denatured Foods" are catalogued and scored in no uncertain language. In "The Science of Savory Cooking," right and wrong ways of preparing food for the table are distinctly set forth Cooking is a science that electricity is soon to make exact. The specialties of France, of England, of Italy, and of Germany are given separate chapters that make us hunger as we read. In "Gastronomic America" we retrace the good old, well-nigh abandoned ways that made our tables tempting in the extreme. The masterly monograph concludes with reflections on the commercial value of flavor and the gastronomic value of odors In many instances, our purveyors are overreaching themselves and are actually inviting loss instead of profit. In butter-making, for example, the greedy manufacturer adds excessive salt because it is cheaper than butter. Yet the more highly salted the butter, the less its market value; in this case dishonest ends defeat themselves! Mr. Finck has years of food-research behind him, and a thorough knowledge of his subject Hence his book is not only delightful reading, but is helpful and instructive to the last degree

Calcul du Beton Arme. Formulés, Tableaux et Abaques. Établis en application des formules de la Circulaire du Ministre des Travaux publics du' 20 octobre 1906. Par Ch. Aubry, ingénieur des Ponts et Chaussees. Paris: H. Dunod et E. Pinat, 1913. 20 francs.

Arduous and thorough labor has gone to the compilation of these formulas, tables, and diagrams, and this labor will save the time and money of the estimator in no small degree. By reference to this work, the worker in reinforced concrete is enabled to arrive at speedy results which would otherwise mean hours of laborious study and calculation. The author admits that into so large a mass of figures some errors may have crept. He will appreciate the report of any such that are discovered. The *abaques* are supplied upon loose leaves in a separate folio. Their convenient form and the clearness lent by their magnitude will not fail to appeal to the reader.

A History of Land Mammals in the Western Hemisphere. By William B. Scott, Ph.D., LL.D., Blair Professor of Geology and Palæontology in Princeton University. New York: The Macmillan Company, 1913. 8vo.; 693 pp.; illustrated with 32 plates and more than 100 drawings by Bruce Horsfall. Price, $5 net.

The author's university colleagues have given him the benefit of their advice and assistance in the preparation of his work, which aims at making a somewhat difficult subject intelligible to the layman. Prof. Scott's own career was determined by a student's fossil-hunting expedition undertaken in the picnic spirit, as it were. The enthusiasm then generated breathes in every line of his work. He has taken great pains to make plain to the reader the methods of investigation, and the part which the successive modifications of bone and teeth play in the reading of these relics dug from the maw of the earth. The introductory chapters are followed by classification and geographical distribution of mammalia and the successive faunas of North and South America; and the body of the history is followed by a discussion of the modes of mammalian evolution. A glossary and index are included, and the illustrations, showing restorations of prehistoric animals and scenes, deserve a word of praise for their care in preparation and for their convincing quality. In type, paper, and cover design the volume is a most attractive example of the publishers' art.

A Cornish Giant. By Edith K. Harper. New York: Spon & Chamberlain, 1913. 61 pp.; 12 illustrations. Price, 40 cents.

"A Cornish Giant" is a biography in pamphlet form of Richard Trevithick, the father of the locomotive. The brief biography is particularly addressed to the people of his own county, but this will not spoil it for those who delight in reading of pioneer inventors and their inventions. The relations between Trevithick and James Watt are amusingly sketched, and as we read we warm toward the solid personality of the six-foot-two blue-eyed Trevithick, misunderstood, jeered, ill-treated, yet always unconquerable—"the greatest and worst-used man in the county."

Ships and Ways of Other Days. By E. Keble Chatterton. Philadelphia: J. B. Lippincott Company, 1913. 8vo.; 308 pp.; 130 illustrations. Price, $4 net.

Uniform with the author's "Sailing Ships and Their Story," this beautiful volume chronologically considers the ways and means by which men built, launched, equipped, and set out with the craft of their various centuries. We learn how men handled these craft, both in peaceful navigation and in war. Still further is attempted; for we are introduced to so intimate a knowledge of the life afloat that we become one with it. None who delight in the landless ocean, and the tumbling and tossing upon it, can fail to have, in reading this story, a sense of dreams come true. He may work the tides with Cæsar and William the Conqueror in their invasions. He may thrust Time back yet farther. For, thanks to old MSS. and curious drawings, we may enter largely into the hulls of the second century, and listen to the exclamations of those who marvel at the dimensions of some newly-completed monster of that day, just as we talk to-day about an "Imperator." Magdalene College, Cambridge, has permitted the reproduction in this work of illustrations from MSS. in the Pepysian Library. One shows a sixteenth century ship designer at work, another, the interior of a seventeenth century ship; still another, the "orthographick simmetrye" of the same. These are but a few of the valuable illustrations to be found in the work.

The Romance of Submarine Engineering. By T. W. Corbin. Philadelphia: J. B. Lippincott Company, 1913. 8vo.; 316 pp.; illustrated. Price, $1.50 net.

Although the submarine boat has been employed as an engine of war since 1776, it is a curious reflection that as yet not one enemy has fallen before it. The only victims have been the crews. Mr. Corbin's book is a popular account and description, not only of submarines, but ship-salving, recovering sunken treasure, the building of breakwaters, and in fact all human accomplishments where it is necessary to work beneath the water. These are themes that invite adventurous handling, and the author has taken full advantage of his opportunity. We read of the feats of the divers, of the breakwaters built with "fifty-ton bricks," and of the secret air-purifying compositions used in connection with diving apparatus. Thus, with thumb-nail sketches of the heroic men and illustrated details of their tools and their work, the author constructs for general reading a very pleasing volume.

Handbuch fur Heer und Flotte. Enzyklopädie der Kriegswissenschaften und verwandter Gebiete herausgegeben von Georg von Alten, Generalleutnant z. D., fortgeführt von Hans von Albert, Hauptmann a. D., unter Mitwirkung von mehr als 300 der bedeutendsten Fachautoritäten. Berlin: Deutsches Verlagshaus Bong & Co., 1913.

One of the most important articles which has thus far appeared in the "Handbuch fuer Heer und Flotte," of which installments 61 to 64 lie before us, is that of General Count von Schlieffen on the Battle of Jena, and the reason why the Prussians suffered defeat in that memorable engagement. The present installments of the Handbuch take the student from "Istein" to "Kaiser-Friedrich-Klasse." The more important articles of a military character are those on the military powers "Italy" and "Japan." No less than eight authorities collaborated in producing the article on "Italy." The article on "India," too, deserves comment. It was prepared by the well-known authority Lieutenant Colonel de Juge. Lieutenant General von Zwehl writes an illuminating essay on Infantry and juvenile military education. Tables, charts, illustrations and diagrams have been freely used throughout these installments.

The Cadillac Company has no intention of marketing a six cylinder car

THE Cadillac Motor Car Company has always believed that there are so many good features in the Cadillac Car, that its advertising space could be best utilized exclusively in acquainting the public with those advantages.

We regret, however, that the occasion arises which makes it appear desirable for us to depart, temporarily, from that policy.

Inasmuch as it is not possible for us to control the "mouth to mouth" advertising with which we are favored, and inasmuch as that gratuitous publicity may sometimes contain elements of inaccuracy, unintentionally perhaps, on the part of the authors, we feel that we would not perform the duty which we owe to the public and the duty which we owe to ourselves, if we did not correct any misunderstandings or misconceptions which may exist concerning the methods, policies and plans of this company.

The pre-eminent position of the Cadillac Car as the "Standard of the World," its recognition as the criterion of excellence in practical construction, are not matters of mere chance.

For eleven years the Cadillac has been manufactured and marketed upon well defined principles. Adherence to those principles has been the dominant factor in Cadillac success.

The Cadillac has never aspired to ideals set by others; it makes its own ideals and raises them higher and higher.

The Cadillac has never striven after the achievements of other plants; it is a school and a model unto itself.

The Cadillac has never been obliged to make apologies for its product. It has never been obliged to smother its past, nor to discredit it by wiping the slate clean and beginning all over again.

The immaterial and the impractical, the fad and the fallacy, the delusion and the shallow "talking point" have no chapter in the "Story of the Cadillac."

The "Story of the Cadillac" is the story of that mechanical and commercial advancement which makes for permanency. The Cadillac product has been only that which its makers knew to be right; that which its makers knew would satisfy and give to the purchaser "value received" in abundant measure.

The policy of the Cadillac Company has ever been to avoid exaggeration and overdrawn statements. Its policy has ever been to under-claim rather than to over-claim.

The Cadillac Company is gratified that the public feels secure in accepting Cadillac representations at their full worth. These representations are so accepted because the Cadillac Company has never misled and because the public could always expect and has always received more than was offered.

The Cadillac Car of today has behind it the experience gleaned in the successful production of the seventy-five thousand Cadillacs which have preceded it—by far the greatest number of high grade motor cars produced by any one manufacturer in the world.

The Cadillac Company is ever alert—its ear is ever to the ground; it feels the throb of the public pulse. Yet never has it yielded to clamor by giving endorsement to principles which would take advantage of the uninitiated or the uninformed, even though temporary benefits might accrue.

The experimental division of the Cadillac Company is not excelled in the motor car industry. We do not believe it is even equalled.

Every design, every appliance, every idea, every principle offered which has a semblance of merit, is subjected to the most gruelling tests

For every idea or feature adopted or considered worthy of the Cadillac seal of approval, scores are discarded.

One reason why most of the new ideas of inventors and manufacturers are first offered to the Cadillac Company is because these inventors and manufacturers realize that with the Cadillac seal of approval, their future is practically certain.

As an example, take the electrical system of automatic cranking, lighting and ignition, first introduced by the Cadillac Company and now used almost universally.

Take also the two-speed axle introduced into the present Cadillac, and which engineering authorities on both sides of the Atlantic are predicting will soon come into general use

Witness this from "The Automobile Engineer" published in London, England. In commenting upon Cadillac engineering progress and Cadillac initiative, it says:—

> "Already there is a very decided movement among other makers to try and provide some type of two-speed rear axle similar to the Cadillac, for 1914 or 1915."

In our experimental division we have built automobile engines of almost every conceivable type and size and have tested scores which we did not make ourselves.

We have built them with one, with two, with three, with four and with six cylinders We have never tried five.

We have cast them en bloc, we have cast them in pairs and we have cast them singly. We have made them with water jackets cast integral and with copper water jackets. We found the latter method most expensive, but the most efficient—hence we use it.

We built cars with one cylinder engines, more than 15,000 of them, and they were good ones "One-lungers" they were called, and they are practically all going yet, after eight to eleven years of service, hundreds of them having passed the 100,000 mile mark.

We built a few cars with two cylinder engines and they were as good as that type could possibly be made. But we never marketed any of them although the rumor was current that we intended doing so.

Yes, and we built cars with three cylinder engines, as good of that type as could be made. Probably few readers ever heard of such a car. Some people thought they wanted that kind and they bought them But not from us. Rumor had it, however, that we intended to market them.

Cars with four cylinder engines! We have built and distributed more than sixty thousand (60,000) of them. That was something more substantial than a rumor.

Cars with six cylinder engines! We have built a number of them in the last four years We have tested them to the utmost, and they proved to be good ones—by comparison. In fact, by comparing them point for point with a number of the most highly regarded "sixes," which we bought for the purpose of making comparisons for our own enlightenment, we failed to find a single car which, in our opinion, outpointed our own, and our own outpointed most of them

These experiments may have given rise to the rumor that the Cadillac Company contemplates marketing a six cylinder car But,—as in the cases of the two and three cylinder cars —such rumor is entirely without foundation. This Company has no such intention.

And we made other comparisons as well, in fact nothing worth while was overlooked or omitted.

Our tests, investigations, experiments and comparisons demonstrated conclusively to us, that a four cylinder engine, designed with the skill and executed with the precision which characterizes the Cadillac engine—and scientifically balanced, affords the highest degree of all 'round efficiency possible to obtain.

These tests further demonstrated that with such an engine, in conjunction with a properly designed two-speed axle, there is obtained an extraordinary range of operating flexibility, an extraordinary reduction of friction, an extraordinary degree of operation and maintenance economy, an extraordinary degree of luxurious riding qualities, and a reduction of vibration, particularly at high speeds, almost to the vanishing point

We have cited the foregoing facts because we believe that the public is entitled to know them, because we believe that we owe it to the public to make the facts known and because we want the public to know that the Cadillac Company leaves no stone unturned, that it spares no expense in its efforts to discover and to provide that which it knows to be right, that which it knows will satisfy and that which will give to the buyer "value received" in abundant measure.

And above all, the Cadillac Company has no intention of departing from that policy.

There can be no better evidence of the appreciation of the Cadillac policy than the fact that there have already been manufactured and distributed, more than 9000 of the 1914 Model Cadillacs, amounting in selling value to more than eighteen millions ($18,000,000) of dollars—a volume of cars which nearly equals, if it does not exceed, that of all other 1914 high grade American cars combined, selling at or more than the Cadillac price, regardless of their numbers of cylinders.

CADILLAC MOTOR CAR CO.
DETROIT, MICHIGAN

The Magic Flight of Thought

AGES ago, Thor, the champion of the Scandinavian gods, invaded Jotunheim, the land of the giants, and was challenged to feats of skill by Loki, the king.

Thor matched Thialfi, the swiftest of mortals, against Hugi in a footrace. Thrice they swept over the course, but each time Thialfi was hopelessly defeated by Loki's runner.

Loki confessed to Thor afterwards that he had deceived the god by enchantments, saying, "Hugi was my thought, and what speed can ever equal his?"

But the flight of thought is no longer a magic power of mythical beings, for the Bell Telephone has made it a common daily experience.

Over the telephone, the spoken thought is transmitted instantly, directly where we send it, outdistancing every other means for the carrying of messages.

In the Bell System, the telephone lines reach throughout the country, and the thoughts of the people are carried with lightning speed in all directions, one mile, a hundred, or two thousand miles away.

And because the Bell System so adequately serves the practical needs of the people, the magic of thought's swift flight occurs 25,000,000 times every twenty-four hours.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

JUST PUBLISHED

Wireless Telegraphy and Telephony

Simply Explained

By ALFRED P. MORGAN

170 Pages, 156 Illustrations Price $1.00 Postpaid

The simplest, latest and most comprehensive popular work published on wireless, for the wireless operator, amateur or professional

THIS is undoubtedly one of the most comprehensive treatises on the subject, and a close study of its pages will enable one to master all the details of the wireless transmission of messages The author has filled a long-felt want and has succeeded in furnishing a lucid, comprehensible explanation in simple language of the theory and practice of wireless telegraphy and telephony.

The book treats the subject from an entirely new standpoint. It is well illustrated by over one hundred and fifty interesting photographs and drawings All diagrams have been made in perspective, showing the instruments as they actually appear in practice. The drawings are carefully keyed and labeled. Many of the photographs are accompanied by phantom drawings which reveal the name and purpose of each part.

A book the wireless experimenter cannot afford to be without. It enables one to design and construct apparatus. Also valuable to the layman

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THE DRAMATIC MIRROR CO., 145 West 45th Street, New York City

An Organ on Which Color Compositions are Played

(*Concluded from page 162.*)

high degree of pleasure to the sensitive observer. Scriabine, the Russian musician, in a recent orchestral composition, has attacked the corresponding color score, although the work in its twofold aspect has not yet been performed.

For years the term "tone-pictures" has been applied to musical compositions, and the art of orchestral coloring has been made the subject of many treatises. But the new art is not limited by the correspondence of shades of color to musical tones. Immensely more delicate gradations may be obtained in color than are possible in musical sounds. We know, for instance, that in music a dominant note, its major third and perfect fifth together, make up the major chord of that key. Lower the middle note of the chord by a semitone, making it a minor third, and we have the minor chord of that key—a very different thing indeed. Much more delicate gradations would be obtained on the color organ.

The craving of the mind for a definite key seems to hold good of a color composition and, as before remarked, the influence of rhythm is very perceptible. A color composition having a strong march rhythm is as effective as a musical composition in the same style, and Prof. Rimington tells me that he has actually waltzed to a color composition composed in waltz time.

Apart from their purely artistic value, many of these experiments are extremely interesting from the psychological point of view.

Prof. Exner, of Germany, has made investigations to determine how far similar colors affect the majority of people in the same way, but only with regard to single colors, and upon some points he obtained great unanimity of opinion. But the importation of rhythm into color widens the field of such investigations enormously, and numerous possible experiments will at once occur to the reader. Such experiments will doubtless help us in framing an answer to the extremely difficult question: Why are certain color compositions, and not others, considered beautiful? The whole question of the origin of the feeling for beauty is very complex and any aid to the solution of the problem must be heartily welcomed. Prof. Rimington, in his work on the subject, advances several arguments to show the great importance of a developed color sense to a community from the point of view of its commercial prosperity as well as its æsthetic development. It is to be hoped that many other workers will enter this richly fruitful field of investigation, and to America, with its keen interest in new developments, its strong artistic and psychological schools, and its readiness to endow research, we may confidently look for further elaboration of the new and fascinating art of Color Music.

The Coolidge Roentgen Ray Tube

(*Concluded from page 157.*)

the most important contribution to Roentgenology since the birth of that science, and it has found an important place in various fields.

Through the courtesy of Dr. Lewis Gregory Cole, Professor of Roentgenology at Cornell University Medical College, we were able to examine one of the new tubes which has been used with notable success. Not only is the operator able to adjust it with greater accuracy, but he is assured of stability and exact duplication of results, greater flexibility, a greater output of rays, a longer life of the tube, and the absence of indirect rays developed at various parts of the glass bulb which, of course, affect the sharpness of the impression. The new tubes have a vacuum about 1,000 times as great as the vacuum of the ordinary Roentgen ray tube and make use of a tungsten filament as a cathode, the material out of which, as every one knows, the filament in the ordinary tungsten incandescent lamp is made. This cathode, unlike that in the older type of tube, must be heated in order to render the tube active and capable of being ex-

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PATENTS

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LEARN TO WRITE ADVERTISEMENTS.—Earn $25 to $100 weekly. We can positively show you by mail how to increase your salary. Prospectus free. Page-Davis Co., Dept. 59, Chicago, Ill.

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PATENT FOR SALE. A first-class household article, very simple, made of sheet steel stamping. For full particulars address Wm. Pfeil, [illegible] East Ferry Street, Buffalo, N. Y.

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HOW TO RUN A LATHE. A 50-cent book for 10 cents, postpaid. Stamps accepted. By a practical machinist and a mechanical engineer. South Bend Lathe Co., South Bend, Ind.

INQUIRIES

Inquiry No. 9347. Wanted the name and address of an industrial school where shoemaking is taught in all its branches

Inquiry No. 9348. Wanted the name and address of manufacturers having useful household necessities, with a view to obtaining exclusive territory for a house to house canvass

Inquiry No. 9349. Wanted the names and addresses of the makers of machinery for making Malt Tonic, also a machine for making grease, and machines for applying plaster (Cement Gun).

Inquiry No. 9350. Wanted the name and address of the manufacturer of a printing press for the printing of tapes for clothing The machine should preferably be worked by hand.

Inquiry No 9351. Wanted to make some article out of wood which could be made from 2 inch [illegible], by party having 75,000 or more feet of waste per year which is now used for fuel.

Inquiry No. 9352 Wanted the name and address of a person who is in a position to get the state or county agency for articles of merit that can be sold to business houses or others at $2.00 or over. No kitchen utensils desired

Inquiry No 9353 Wanted the name and address of a manufacturer who can make flexible oil cans.

Inquiry No 9354. Wanted the name and address of a manufacturer of a machine which will stitch silk around small metal rings.

Inquiry No. 9355 Wanted the name and address of the maker of triplex glass.

Inquiry No. 9356 Wanted the name and address of a manufacturer who can build an *automobile wheel*, also a *cigar vending machine*. Concerns in the middle West preferred.

Inquiry No. 9357. Wanted the name and address of a manufacturer of a machine for scalloped paper favors and cups.

Inquiry No. 9358.—Wanted the name and address of maker of a machine to cut all granulate leather.

Inquiry No. 9359 Wanted the name and address of a firm that makes razor blades for all makes of safety razors

Inquiry No. 9360. Wanted the name and address of parties making pipe fittings such as ferrules, shanks and bowls such as could be used in the making up of calabash pipes for smoking.

Do You Want to Sell Your Invention?

Every patent commercially valuable would be quickly bought at a good price, or money promptly furnished for its exploitation, if investors could be (1) absolutely assured of its validity, and (2) insured against the danger of infringement.

Make your patent salable by insuring it!

We issue a policy which will insure its validity and protect it against infringements. We furnish expert reports on the commercial possibilities of patents and novelties We arrange, through our world-wide connections, for their purchase outright or for funds with which to put them on the market.

If you wish to sell your invention, or to [illegible] royalty basis, write for particulars to the [illegible]

J. M. WILSON, Patent Attorney
37 Liberty Street NEW YORK CITY
Representing The Letters Patent [illegible]
[illegible]

[illegible] When a current from a storage battery raises the tungsten filament to the required temperature the electrons are liberated from the cathode by the high potential current ordinarily employed and furnished from an induction coil or transformer.

The penetration of the rays from the tube depends upon the rapidity with which the electrons are thus shot out from the cathode, and this speed is controlled by regulating a low potential current from a storage battery in circuit with the tube, which acts to generate heat in the cathode filament. With one of the new tubes using a filament of twenty-five milliamperes, the stability of the tube will remain permanent for fifty minutes without perceptibly changing the penetration. This gives a Roentgenogram with a uniformity of excellence which has never before been obtained; and after the tube is adjusted to the desired degree of penetration for any given part of the body it may be excited with any desired milliamperage from 1 to 200, for the time required for a correct exposure. Uniform results can be obtained by decreasing the current and increasing the exposure or *vice versa*.

The controlling apparatus is such that an exact duplication can be obtained and, at the same time, the tube is so flexible that it can be operated at a penetration so slight as to show the fine blood vessels of the hand or foot at one instant, while at the next it can be increased so that a penetration far exceeding anything possible with the ordinary tube can be secured, thus making it available for all kinds of Roentgenographic and therapeutic work.

The life of the new tubes is placed by Dr. Coolidge at a minimum of a thousand hours of constant running, so that the tube is more likely to be impaired as the result of accident than from wearing out. The new tube avoids the detrimental effect of the indirect rays generated in the wall of the anterior hemisphere of the tube by secondary or deflected cathode streams which blur the image and give rise to secondary rays in the tissues of the body interposed. To one seeing the apparatus for the first time the utter absence of fluorescence in the glass is most marked.

With the new tube a scale of length of exposure and current required with different lengths of spark gap has been compiled which shows exactly what is needed in photographing the various parts of the body. In one instance ten exposures were made in 4/10 of a second of actual time With the stomach, using a spark gap of five inches and a current of 110 milliamperes, the time of 0.06 second was required, while for the detail of the spine, using a current of 30 milliamperes, 15 seconds would be required.

The original tests made in the research laboratory with experimental apparatus on animal tissue and strips of metal were repeated in Dr. Cole's laboratory and a series of test plates were made which showed clearly the differences obtained by varying the conditions in a number of exposures on the same subject.

A New Scheme for Selling Patents

IN a neighboring city not far from New York, there is a patent bureau bearing a foreign name, which puts forward a claim of having special facilities for selling patents abroad. The carefully worded correspondence which this bureau carries on with the inventor is alluring in character and is designed to entice the unsuspecting client into its fold.

As soon as a patent is issued in the United States, an attractively worded letter is received by the inventor, informing him that the parties of the first part make frequent trips to Europe and are in direct contact with European manufacturers and act as their agents, and that such manufacturers are anxious and eager to undertake the manufacture of this particular patent on royalty basis, or buy the patent outright for a reasonable amount. They usually state that they consider the patent very valuable for the European market, and "we could contract the manufacturing right on a strictly commission basis of ten per cent." They then state further:

"If you have no foreign patents, would you consider an offer for the manufacturing rights? Are you open for an offer? Kindly reply. We mean business."

All of the above suggestions are in the body of the letter and are typewritten. Then written in ink in a broad and scrawling hand, is the following: "We are able to close a contract with a German manufacturer."

We are constantly receiving letters from inventors who have received these circular letters from the parties above named, and who are considerably excited over the prospect of closing a contract for the sale of a foreign patent when perhaps no patent has yet been obtained there. It may or may not occur to the inventor that it is a singular thing that within a few days of the issuing of his United States patent a German manufacturer should be eager to step in and make a contract for the German rights. In his eagerness, however, to launch the new enterprise the inventor is usually taken unawares and does not reason out the inconsistency of the proposition.

One of our correspondents wrote to the "Patent Bureau" as follows:

"*In your former* letter of December 13th you say in a postscript, 'We are able to close a contract with a German manufacturer.' I suppose by this that you mean you have a definite manufacturer in view with whom you know that you can make a contract. I asked you specifically on this in my letter of December 23rd, but you disregarded my inquiry in your last letter.

"When you write please give me the fullest information on the matters I have requested, as a fair and clear understanding is very essential for doing business satisfactorily."

In reply to this letter, which the Editor has before him, this question in regard to who the manufacturer is who is ready to sign the contract, and whether there is such a definite manufacturer ready to sign the contract, remains unanswered. We suggest to the guileless inventor who may be enticed to open correspondence with these parties to assure himself in regard to these facts before entering into any contract with the parties in question We are of the impression that the inventor will discover before any negotiations can be entered into that a considerable payment will be exacted in each country before any disclosure will be made.

They state in a letter which we have before us:

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If the reader has a patent which he wishes to sell in a foreign country we suggest before making any arrangements involving the payment of any retaining *fee that he shall demand full information* in regard to what success others have achieved, and who the parties are who are so anxious and eager to close a contract in some foreign country almost simultaneously with the issuance of the patent here.

A Recent By-product Utilization in American Soap Manufacture

By L. Lodian

IN all soap manufactories there accumulates in due course a soap-kettle refuse known in the trade terminology as the "nigre." What to do with this "nigre" has long been a problem to the student of the soap industry. True, he could work some of it up with low-grade colored soaps, make it into the so-styled black tar soaps or use it for a brown-black dog soap as a flea killer. But tar soaps are of exceedingly limited use, while any soap white or colored is a good destroyer of fleas, as the alkali lather attacks them instantly.

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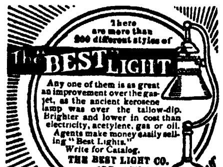

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"nigre" has been used for the turning out of the course brown bar-soap known as carbolic soap (10 to 20 per cent of the acid being worked into the "crutch" or kettle-boil), and this is extensively used there as a disinfecting hospital-floor or prison-floor scrubbing soap; while it also makes a capital cleansing soap for carpets and garments. On the other hand, in America carbolic bar-soap is scarcely known, especially in the city retail stores, while its use as a fair-grade toilet soap is almost a negligible factor. The odor is disliked by the vast majority of people, so there has never been any chance for the "nigre" in that direction.

So what to do with the "nigre" remained a question. It was thought to be worth more than for fuel use, or for running away as waste, so one large company decided to experiment; and two years ago it put on the market a quantity of cases of the kettle-refuse soap, at a price lower than any other soap, i. e., two big laundry size cakes for five cents. Its salesmen said that it would never succeed, that its blackish-brown color would be against it.

To the surprise of the Jersey City nigre-soap outputters calls came from retailers for more cases, and the manufacturers constantly replied that there was not enough "nigre" to supply the demand. This condition has continued up to the present time

What is all the more remarkable is that the American firm has succeeded in marketing a far more difficult refuse-product than ever appeared in Europe. What is wasted there is here utilized. The veriest dregs of the soap-kettle, consisting of refuse membraneous-tissue particles and even the tiny sand-like bony, gritty minute portions which settle to the bottom of every kettle, are all utilized now in this nigre-soap An advantage too lies in the fact that in washing practice, these fragments cause a slight friction sufficient to form a foaming lather

Nigre-soap must necessarily be a cheap compound, a resin-and-salt product; consequently it sweats in humid weather like the low-priced toilet-soaps to an almost unpleasant stickiness, and "blooms" or effloresces some of its elements in dry spells In the wash though it acts and wears well and can be used on the most delicate bleached silks, which properly rinsed show a snow white appearance, as the foam from the soap has little color—a feeble dinginess only The cake wears down without breakage to an almost paper-thin tablet

Altogether, considered as a by-product, this nigre-soap is a creditable one, and it reveals what may be accomplished by trying and what one firm has successfully marketed in the East, others in various sections of the country might duplicate.

The refuse membraneous-tissue dregs or filaments, in an extremely comminuted form, naturally segregate in the molten grease, and after working into soap, they are often still found in the cake in an agglomerated condition—dissolving, however, in the wash uniformly with the rest of the soap The congregated refuse tissue seen here and there in parts of the contrasting smooth-grain black-brown soap, often presents an almost picturesque appearance, especially when wet, as of rare-marked mahogany specimens, or beautiful dark-hued fossils

According to Lamborn, the ensuing analysis of the average nigre soap-kettle refuse explains its make-up.

Water	64.32 per cent
Soap, anhydrous	29.04 per cent
Alkali, free, NaOH	0.52 per cent
Alkali, combined, Na_2CO_3	2.17 per cent
Non-determined	3.95 per cent

A soap works instances a fraudulent use of the by-product in low-grade or certain dark-colored toilet soaps, it also lists all of the dishonest "fillers"—talc, barytes, earths, mineral fillings, and the other tricks for weighting soaps; and these are mentioned so that the reader may be warned against their use.

The American Forestry Association has just elected Henry S. Drinker, president of Lehigh University, and P. S. Ridsdale, as its president and secretary, respectively.

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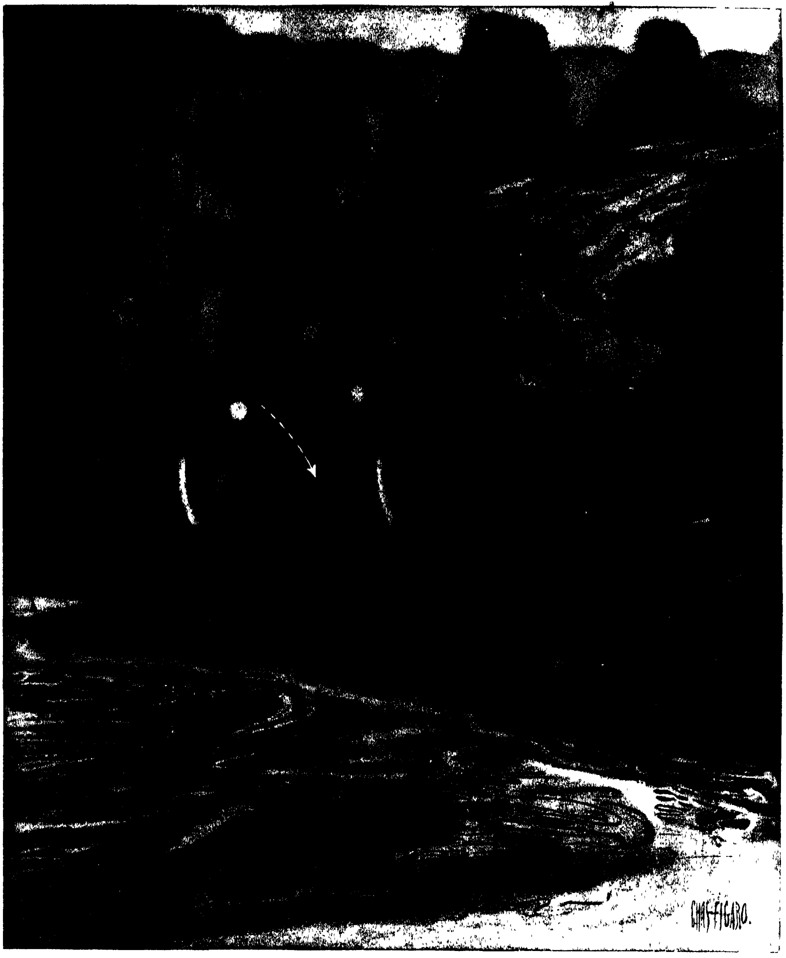

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By Hon. FRANKLIN D. ROOSEVELT, Ass't Secretary U. S. Navy

Vol. CX. No. 9
February 28, 1914

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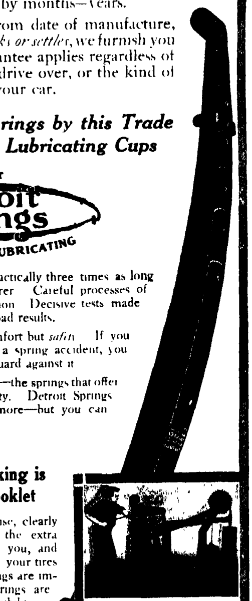

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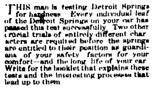

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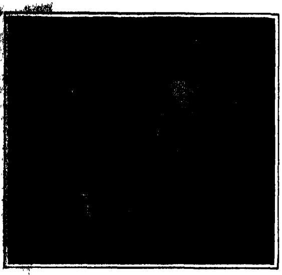


Method of removing the outer bark in preparation for setting the apron and the cup for a flow.

Streaking or chipping. Starting the face. Note the nail (below the apron) upon which the cup is set.

Showing the method of setting the apron in orchard turpentining after removal of the bark of the tree.*

Prolonging the Naval Stores Industry

By Samuel J. Record, Assistant Professor of Forest Products, Yale University

THE future of the naval stores industry in the United States is a matter of grave concern. Wasteful methods of boxing and chipping are carried on in advance of logging operations and no provision is made for continual production. Long leaf and Cuban pines of the South have long been the chief source of the world's resin supply, but the stands of these trees are rapidly being cut. The demand for naval stores, however, is increasing, and this has led to the boxing of smaller trees and of species which formerly were not considered worth while. With depletion of the forests the industry has advanced farther and farther west until practically the whole range of long leaf pine has been covered. There is no other region to exploit unless it be the far West. Investigations of the yield of resin from western pines indicate a possible future for the naval stores industry, but it can never approach conditions in the south Atlantic States.

Decrease in supply has also stimulated the distillation of pine wood and while there is considerable prejudice against the turpentine thus obtained it nevertheless has a promising future. Improved methods of distillation are coming into use which overcome most of the objections to wood spirit.

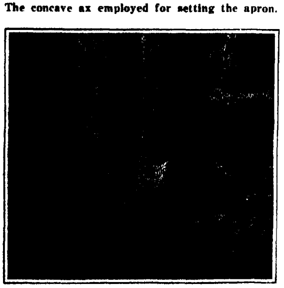
For ten years the United States Forest Service has been experimenting with improved methods of turpentine orcharding. *Instead of the destructive box cut* into the base of the tree, thereby weakening it and rendering it particularly liable to fire damage, a system of cups and gutters was shown to be successful. The adoption of this method has been slow and even at the present time the old way is still common.

The next important feature of turpentining presenting itself for investigation was in regard to the proper depth, width and height of the wound made on a tree in chipping. Some of the results of the comparative experiments conducted on a commercial scale under normal conditions demonstrate that combined shallow and narrow chipping increases the yield; that the number of trees killed is decreased; and that the damage to the lumber in the butt cut of chipped trees is reduced.

Light cupping, that is, restricting the operation to timber over twelve inches in diameter, and closely limiting the number of cups per tree, has proved to be highly advantageous since it prolongs the period during which a crop can be worked and by exempting the young trees prevents the exhaustion of the timber available for turpentine in future, thus assuring stability and perpetuity to the naval stores industry.

Resin will not continue to flow indefinitely from a cut, hence frequent chipping (once a week or oftener) throughout the season is necessary to maintain the flow. Cuban pine bleeds much longer than any others, producing almost no "scrape." The thickness or rather the height of the chip taken off determines the rate of advance of the face up the tree. The more cut off at a time the sooner the face will get beyond the reach of the chipper. It has been demonstrated that a thin shaving will accomplish as good or even better results than a heavy cut. With the ordinary hack, however, this is difficult to regulate, and a new hack has been invented which works on the principle of a safety razor. The thickness of chip can be gaged accurately even after repeated sharpening of the hack blade. It is so made that the inside edge is flat instead of curved, thus leaving the cut face smooth instead of scalloped. This facilitates the flow of resin into the cups.

The operation of making the groove in the tree. The concave ax employed for setting the apron.



A fairly typical face. The hack, which shaves on the principle of a safety razor, lies beside the tree.

The question of running the face spirally instead of straight up the side of the tree is being considered. The advantage of the spiral would be in extending the length of time a tree could be chipped before the face got beyond reach of the long-handled hack. It might at first appear that the effect of a spiral face would be to girdle the tree as soon as it had extended entirely around. Such is not the case, however, since the movement of the sap is not in straight lines, but from one cell to another through pits in the side walls. The sap stream would accordingly follow the spiral of uninjured wood without material interruption.

A method of resin gathering for which a great deal has been claimed consists of boring slanting holes in the sapwood and draining the resin into a closed cup. This was supposed to prevent the closing of the resin ducts by oxidation of the resin, thus permitting a continuous flow. This and similar methods fail to take into account the physiological processes involved in resin formation.

Resin is a waste product resulting from the vital processes of growth. It is not, as many assert, a healing balsam especially produced by the tree to protect wounds, such a function of it being purely incidental. In the change of starch into exactly the kind of food the plant wants a complex substance is left over as a *by-product. This is called resin and is found in* parenchyma cells since they alternately store up and give out starch and other plant food, according to the season.

If several resin cells or parenchyma cells are close together the amount of by-product (resin) becomes too large to be contained in the cells and is excreted into intercellular spaces. Such spaces are known as resin ducts and are characteristic of the wood of our pines, spruces, larches and Douglas fir. Most of them extend up and down the stem, but many occur in the large medullary rays. These ducts are for use in the storage of resin and not for its transfer from one part of a tree to another. In this function as well as the absence of a wall of their own they differ from the vessels of hardwoods. None of our hardwoods contain resin ducts in the wood, though many species of *Dipterocarpaceae* in the Philippines are so characterized. The milk of dandelion, of milkweed, and the latex of rubber trees is also a by-product similar to resin in formation.

In tapping a tree comparatively little resin is actually secured from the ducts already in the wood. The main flow is not out of the old ducts like sap out of cut vessels, but is from new ducts which arise as a consequence of the injury. Wounding, such as chipping, stimulates the vital processes at the seat of injury and greatly increases the by-product, resin, and in consequence there is an increase in the number of ducts necessary to contain it. It is from these secondary ducts that most of the commercial yield of turpentine is secured.

The first wound results in the formation of a number of new or secondary resin ducts from both above and below the injury, the length of those above being greater than those below. Subsequent chipping of course affects only the upper edge of the first wound. The first wound is usually made in winter when all hands are engaged either in placing the cups on the

(Concluded on page 186.)

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Problem of Our Navy

THE SCIENTIFIC AMERICAN commences in this issue the publication of a consecutive series of articles on "The Problem of Our Navy," than which problem, as affecting our international interests and our standing as a great world power, there is no question before the people of the United States and its Congress of greater and more pressing importance.

During the past thirty years, or since the time when a Democratic Administration commenced the construction of an entirely new navy of steel, and set afloat such cruisers as the "Chicago," "Olympia," and the vessels of "The White Squadron," and that famous trio of battleships, the "Oregon," "Massachusetts," and "Indiana," the SCIENTIFIC AMERICAN has recorded the steady growth of the Navy, *so far as its materiel is concerned*, and by photograph, drawing and descriptive text, has kept the public in close touch with the various ships, as they came from the builders' hands and went into active commission.

We feel that the time has now come to take a broader view of this most important subject, and show how vitally the Navy is related to those stupendous international policies, such as the Monroe Doctrine, the Integrity of China and Asiatic Exclusion, upon which the United States has recently taken such a bold stand—with regard to which it is at this very moment assuming an attitude that admits of no compromise whatsoever.

The spirit of the articles will be at once laudatory and critical, and as an evidence of the happy combination of these two attitudes, we direct special attention to the first of the series, by Assistant Secretary of the Navy Franklin D. Roosevelt, as published elsewhere in the present issue.

Canal Tolls Sophistries

DISPATCHES from Washington indicate that the President will meet with strong opposition in the House of Representatives to his proposed repeal of that clause of the Panama Canal Act which exempts coastwise traffic from the payment of tolls. If Representative Underwood, the Democratic leader of the House, is correctly reported in the New York *Times*, he is making an investigation of the probable effect of an amendment to the Canal Act extending free tolls on their domestic commerce to all nations. How this would better the situation we fail to see. To meet the fixed and operating charges of this $400,000,000 enterprise will require the gathering in of every dollar of legitimate earnings that it can secure. Exemption of our coastwise traffic would cut down the revenues enormously; and Mr Underwood's proposal to exempt the domestic commerce of all nations would not only reduce the revenues in a still larger measure, but would make the discrimination most painfully apparent in the case of those nations that have no domestic commerce to send through the canal.

Mr. Underwood is quoted as saying that in the United States we have never charged domestic commerce a toll for the use of any waterway improved at the expense of the Government, and that to do so at Panama would be an innovation. Well, what of it? All new legislation is more or less of an innovation, and in this case the innovation is necessitated by treaty obligations of the clearest and most binding character.

It seems to us that there is more of sophistry than good logic in arguments such as these, and especially in the following: "Now mark this inconsistency," Mr. Underwood is quoted as saying. "The rules for the government of the Suez Canal, as embodied in the treaty of Constantinople, are those we adopted for the government of the Panama Canal. All the principal powers of Europe signed that treaty. Yet, though Russia, one of the signers, makes an annual appropriation to pay the tolls of her domestic commerce through the Suez Canal, Great Britain never has protested." But why should she? The Hay-Pauncefote treaty leaves all nations free to pay back to the shipping companies amounts equal to the tolls charged for passage through the Panama Canal, if they feel disposed so to do. That is a question affecting the individual governments and the shipping companies which may use the Canal. The treaty between the United States and Great Britain takes no cognizance of such matters. If the United States Government charged equal tolls to our coastwise shipping and then voted from the Treasury sufficient money to repay these tolls to the coastwise shipping companies, there could be no protest from Great Britain or any other maritime country against such procedure

Alphonse Bertillon

IN the popular mind the fame of the late Alphonse Bertillon rests entirely on the introduction of the anthropometrical and finger print methods of identifying criminals. Magnificent as was the achievement of co-ordinating the police headquarters of the world, so that it is now a matter of routine for the bureaus of criminal identification in the larger American and European cities to exchange measurements and fingerprints, Bertillon's reputation rests on a broader basis of scientific achievement. Indeed, the anthropometrical system is eventually bound to give way to Galton's fingerprint method, which Bertillon was reluctantly compelled to accept and introduce.

What the police forces of our great cities owe to Bertillon is the injection of a scientific spirit into the work of tracking criminals. His *Bureau d'Identification judiciaire* has been a model laboratory in which the police of the world have been shown how the evidence of crime may be studied scientifically. Its counterpart should be found in every American city—a wish that will probably not be realized for decades to come. When the full significance of the scientific methods that Bertillon introduced into the French police system is appreciated, we will wonder why we ever tolerated the present system, why criminals in this twentieth century are still tracked by detectives who are nothing but promoted policemen and who can use only in the crudest kind of way, the clues that are placed at their disposal. Some day there will be found at the head of every detective bureau a man with Bertillon's outlook and scientific spirit—a man who will have as his subordinates not uneducated policemen and detectives, but men trained to deal with crime in a systematic scientific way.

Requirements of the Automatic Train Stop

WE recommend for the study of all who are engaged on the automatic train stop problem a review, in booklet form, by Mr. Joseph W. Buell of Washington, of the principles underlying the design and construction of automatic stop apparatus as applied to the control of railroad trains. The author, himself an inventor of a well known system, has devoted many years to the study of cab signals and automatic stops and is well qualified to discuss the various branches of this subject and its relation to wayside signaling.

At the outset it is pointed out that previous developments in railway signaling have had to meet exacting requirements; and that the demand for greater efficiency in safeguarding railroads by the employment of automatic stops, necessitates that their design and operating principles be subjected to the same rigid treatment with respect to their pre-requisites, as has characterized previous development in the existing methods of signaling.

After a brief discussion of the engineering rules that govern the problem, some space is given to the physical side of the question and particularly to the perplexing problem of satisfactorily providing either a mechanical or an electrical means for transmitting an impulse from the track to a traveling locomotive in order to actuate the mechanism thereon, and to doing this in as reliable a manner as has been found in the automatic production of a roadside signal on a mast or post.

The various systems of automatic stops offered for approval may be conveniently classified as six distinct methods or types for communicating motion, or producing an electrical effect, on a traveling locomotive by reason of a danger-giving condition of the track. Mr. Buell points out that, in the study of these systems, every aspect of the problem [illegible] simple and there is provided a method for [illegible] the real value of any one of these systems [illegible] considering their relative merits we must [illegible] attention to the vital consideration of the [illegible] excellence of the means used for establishing [illegible] connections, or contacts, between the track and the locomotive. Furthermore, it must be borne in mind that in whatever manner this be done, it is imperative that the operating principle involved shall satisfy the fundamental requirements of observing the engineering rule of "failure on the side of safety."

In dealing with the problem of establishing connection or contact between the track and a traveling locomotive Mr. Buell has classified the different systems, aside from the one which transmits an electrical or magnetic impulse through the air, as follows:

First, a contact obtained by impact or blow. Second, a yielding contact obtained by pressure of a [illegible] part, carried by the locomotive, upon a stationary part on the track. Third, a rolling-wheel contact, obtained by the pressure of the wheels of the locomotive on the traffic rail. Every step in the development of each type is clearly set out, and a brief account is given, in a practical but scientific way, of the various types of automatic stops such as the Trip, Third-Rail, Ramp, Wireless, etc., and the author sets forth impartially the advantages claimed for each; how their merits should be respectfully judged by accepted standards; and at the same time the disadvantages involved in each type are shown. The author finds a prospect for the survival of the Ramp type and the Rolling-wheel Contact Type. The latter he regards as the ideal one for reasons that are given at some length.

There is a demand for literature of a compact but comprehensive form dealing with this problem; and a reading of this booklet will be found useful to inventors in clearing the air, as it were, and setting them on firm ground with regard to fundamental principles and practical requirements.

The Next 900-foot Atlantic Liners

THAT the 900-foot transatlantic liner is a profitable investment is proved by the fact that this summer there will be three ships in service between Europe and America which will be over 900 feet in length. These will be the "Imperator," which, during the winter months, has been undergoing considerable modifications, the new "Aquitania" of the Cunard Line, which is due here next June, and the "Vaterland," of the Hamburg-American Line, which will make her maiden voyage to New York in the early summer. The "Aquitania" is 901 feet long, the "Imperator," [illegible] feet, and the "Vaterland," 940 feet, these being the lengths over all. In the same class should be mentioned the White Star liners "Olympic," now in service, and the "Britannic," which was recently launched and is being rapidly pushed to completion.

The "Aquitania" will be an enlarged "Mauretania," with a displacement about 50 per cent greater. She will be driven by quadruple turbines working on four shafts, and her horse-power will be about the same as that of the "Mauretania;" although the speed, due to the great increase in displacement and the somewhat fuller lines of the hull, will be less. The "Mauretania" has crossed the Atlantic at an average speed of 26.01 knots, and it is expected that the "Aquitania" will be capable of a sustained sea speed of something over 23 knots. With her full equipment on board, the new ship will have a displacement of about 55,000 tons. With a length on deck of 901 feet, she has 97 feet of beam and a plated depth of 64 feet.

The safety elements in the "Aquitania" are broadly similar to those embodied in the "Lusitania" and "Mauretania." For five hundred feet of her length she consists of a shell within a shell, the coal bunkers being carried at the sides of the ship in the wake of the boiler rooms. The inner wall of the bunkers is about 15 feet from the outer shell, and the whole of the boiler and engine spaces is subdivided by six bulkheads extending from side to side. These bulkheads have been specially stiffened; and with them is associated a watertight deck in the neighborhood of the water line. An interesting fact is that the ship will carry two 40-foot and two 30-foot motor lifeboats, which, in case of emergency, will suffice to tow all the other boats, including twenty-five large rowing boats and a large number of the collapsible type.

The "Vaterland," an enlarged "Imperator," is 940 feet long with 100 feet of beam and a plated depth of 73½ feet. She will differ from the "Imperator" in underwater form, being constructed with a cruiser stern and will carry a balanced rudder operated by steering gear which will be entirely below the water line. She will probably be a knot or more faster than the "Imperator," and of four or five thousand tons greater displacement, this at full load being something over [illegible] tons. A sister ship of equal dimensions and beam is under construction at the Blohm & Voss yards, where the "Vaterland" is now receiving her finishing touches.

Engineering

[illegible] the Elevated Railroad.—The Inter[illegible] Transit Company, of New York city, has [illegible] contract for third-tracking the Second, [illegible] Avenue Elevated Lines. The esti[illegible] the work is about $17,000,000.

[illegible] New Railroad Construction.—Statistics [illegible] show that there has been a decrease in the [illegible] new lines under construction from 2,500 [illegible]y 1st, 1912, to 1,522 miles on January 1st, 1913. [illegible]ing to the *Railway Age Gazette*, the out[illegible] construction is not promising for the year 19[illegible] will probably witness a still further decrease. In [illegible] there are 1,568 miles of new line under con[illegible] compared with 3,500 miles one year ago.

[illegible] Coal in 1913.—According to the official esti[illegible] United States Geological Survey, the output of [illegible] the United States during 1913 amounts to be[illegible]0,000 and 575,000,000 short tons. Edward W[illegible], coal statistician of the Survey, has stated th[illegible] mining industry, in spite of an increase of [illegible] over the year 1912, was perfectly normal, [illegible] figures are to be taken as showing the great industrial activity throughout the country.

Ships that Break in Two.—In our recent editorial entitled "Ships that Break in Two," it was stated that an accident of this character occurred to the British destroyer "Viper." The vessel that broke in two was the sister destroyer "Cobra," which foundered in the North Sea on September 18th, 1901, with a loss of seven lives. The Admiralty inquiry showed that her loss was due to structural weakness. Curiously, the "Viper" was lost in the same year through running aground in the Channel Islands.

A Substitute for "Watch Your Step."—The Interborough Rapid Transit Company has perfected a mechanical gap-filling device which will be used at subway stations which are on a curve. It consists of a grated segment of the platform which is thrust forward, filling the gap between car and edge of platform, the movement being made just before the train comes to a stop. The grating remains in this position until the train has started and moved a distance of 7 or 8 feet. The gap-filler is operated by electro-pneumatic cylinder action.

Revival of the Big Sailing Ship.—The development of the heavy oil engine bids fair to bring about a revival of the big square-rigged sailing ship. The latest of this type is a truly magnificent vessel, "The France," launched by the Chantiers de la Gironde at Bordeaux. She is 430 feet long, 55⅜ feet beam and draws 24 feet when loaded to a displacement of 10,650 tons. Her auxiliaries consist of twin Schneider-Carels oil engines of 925 horse-power, which drive the ship at a speed of 10½ knots, the fuel consumption on the brake test being 0.45 pound per brake horse-power per hour. Her lines are finer than those of the ordinary tramp steamer, and under sail alone she should be capable in a whole-sail breeze of making 16 knots.

Stopping Express Trains in Their Own Length.—A most important development of the air brake was demonstrated in recent experiments on the Pennsylvania Railroad when a twelve-car steel train, nearly 1,000 tons in weight, running 60 miles an hour, was stopped within its own length of about 1,000 feet. The new Westinghouse brake may be operated with pneumatic or electric control, and it embodies among other improvements two shoes for each wheel instead of one, as at present. The new apparatus shortens the time of obtaining the maximum brake capacity from 8 seconds in the present system to 3½ seconds. With electric control, the time is shortened to 2¼ seconds. It was shown that a twelve-car steel train running 80 miles an hour could be stopped within 2,000 feet.

A Comparison of Broadsides.—Rear-Admiral Vreeland has filed with the House Committee on Naval Affairs a statement showing that in total muzzle energy of one broadside, the dreadnoughts of the German navy are twice as strong, in the aggregate, as the American dreadnoughts. In pre-dreadnought ships, the United States shows a heavier total muzzle energy than Germany; but combining both dreadnoughts and pre-dreadnoughts the total muzzle energy of the German fleet is stronger than that of the American fleet in the proportion of 11 to 8.

American Manager for English Railroad.—The appointment of Mr. Henry Worth Thornton, General Superintendent of the Long Island Railroad, as General Manager of the Great Eastern Railway Company in England, has been well described as "a personal compliment to Mr. Thornton, and a profound appreciation of American railroads and their men." The appointment has raised the inevitable "tempest in a teapot" in the British daily press. As a matter of fact, the appointment does credit to the judgment of the directorate of the Great Eastern Railroad, which handles the heaviest suburban passenger service into and out of London. Mr. Thornton will look at the problem from new standpoints, and with the advantage of a wide and varied experience.

Science

Soundings in Lake Tanganyika.—Recent soundings in the great African lake by Capt. Jacobs, of the German Navy, showed a maximum depth of 4,190 feet. Still greater depths are reported to have been found by a Belgian official. Accordingly Tanganyika is, with the exception of Lake Baikal, the deepest body of fresh water in the world, and further investigations may prove it to be even deeper than Baikal. In the deepest places thus far found, its bottom is at least 1,600 feet below sea-level.

An Aerial Tramway Across the Andes.—Work has been begun on a remarkable steel ropeway, 37½ miles long, which will serve as an extension of the railway from Ladorada to Mariquita, in Colombia, carrying the line over the Andes at an altitude of 11,000 feet. The steel rope is to be supported on a series of steel towers, from 40 to 125 feet in height, and will consist of 12 sections, at each junction point of which a motor will be installed of sufficient power to work two sections. Power is to be furnished by water brought down from the Andes.

Pili Nuts, which grow abundantly in the Philippines, have recently been shipped on a considerable scale to the United States. They are produced by trees of the genus Canarium, to which belongs the Java almond, are nearly triangular in cross-section, and contain a small oily kernel of almond-like flavor. Besides being very palatable in their natural state, they yield a valuable oil, resembling oil of almonds. According to an official report, the production of pili-oil is one of the coming industries of the Philippines, only awaiting the invention of a machine for cracking the nuts, which are very hard.

The Alaska Reindeer Service.—The latest report on this service, just published by the U. S. Bureau of Education, shows that on June 30th, 1912, the total number of reindeer was 38,476, distributed among 54 herds. Of these animals 62.5 per cent are owned by 633 natives; 9.8 per cent by the United States; and 16 per cent by Lapps. At an average value of $25 a head, the reindeer owned by the natives represent a capital of $601,700. The income of the natives from the reindeer industry during the fiscal year, exclusive of the value of meat and hides used by the natives themselves, was $44,885.04. The total number of natives affected by the reindeer enterprise is estimated at about 6,500.

Standard Tests for Hemp.—According to a report from the American consul general at Hongkong, the Fiber Division of the Bureau of Agriculture at Manila is conducting extensive experiments for the purpose of establishing scientific standards for testing hemp, in lieu of the present methods according to which experts, of many years' experience, judge the quality and value of the product by sight and touch. The new tests will be based upon the relation between the weight of a meter length of the fiber and the breaking strain. Tests for single fibers will be varied with tests for twisted fibers. As soon as this system of tests is fully worked out it will be put into effect in the Philippine hemp market.

Molecular Equilibrium.—O. Lehmann describes a method to determine the elastic limit of a viscous amorphous body. The application of this method to crystalline substances becomes complicated and the phenomena observed can only be explained on the molecular hypothesis and constitute a new proof of this theory. In liquid crystals the molecular equilibrium is related not only to the structure, but also to the form. The molecular equilibrium may be deranged by mechanical forces or by easily graduated magnetic forces. The strong surface tension, for example, produced at the boundary of the air and liquid crystals is able to derange the disposition of the molecules. The molecular perturbations produced by foreign substances able to form crystals mixed with the liquid crystals are the most striking.

True History of the Tepary Bean.—A brief note on the history of the tepary bean published in our science column of June 28th, 1913, and based on a supposedly reliable abstract in a foreign journal of an article by Prof. R. W. Clothier, of the University of Arizona, contained some inaccuracies to which Prof. Clothier has been good enough to call our attention. It appears that the tepary beans were originally found among a lot of beans obtained from the Papago Indians by Director Forbes, of the Arizona Experiment Station. They were tested independently by Prof. Clothier and Director Forbes, at places 400 miles apart, neither seeing the crop grown by the other. Both investigators recognized that they had fallen upon a valuable addition to the crops adapted to the Southwest, and both submitted the beans for botanical identification to Prof. G. F. Freeman, of the Arizona station. During the summer of 1910, Director Forbes and Prof. Freeman visited the Papago Indians in order to seek further information concerning the origin of the beans and secure other varieties. Prof. Clothier has never visited these Indians. The outstanding fact is that Director Forbes and Prof. Clothier are both entitled to the credit of introducing a valuable new crop to the attention of the world.

Aeronautics

A Flight from Cairo to the Cape of Good Hope.—Marc Bonnier, who recently completed a flight from Paris to Cairo, has announced his intention of flying from Cairo to the Cape. The trip may take two months and will be made under the auspices of the National Aero League.

An Optical Telegraph for Flying Machines.—A very interesting optical telegraph was recently tried out at the Breguet aerodrome, near Velizy. The apparatus consists essentially of a tube mounted in the direction of the flying machine's travel. The blast of the aeroplane's propeller is caught by this tube. Hence the tube is traversed by a violent current. Connected with the tube by means of a valve is a small reservoir filled with lampblack. By opening or shutting the valve, puffs of lampblack of greater or lesser duration are produced. It is said that these puffs can be seen through powerful field glasses, for about ten miles, and that a message in puffs projected according to the Morse code can easily be read.

New German Military Zeppelins.—The Zeppelin L. Z. 22 has just been completed at Friedrichshafen. It is intended for army use and will bear the number Z VII. It will be stationed at Dresden, where a new shed is in course of construction. Another Zeppelin Ll 23, is fast nearing completion. It, too, will be taken over by the army, so that the German military Zeppelins will soon number eight. In the Z VII. some important modifications from the standard Zeppelin construction are embodied. In order to avoid a repetition of the frightful disaster sustained by the L II. last December at Johannisthal, the cars in which the engines are contained are hung somewhat lower, with the result that the air may circulate freely between the envelope and the cars. It is said that Count von Zeppelin has definitely abandoned the idea of running the saloon or passageway which connected the two cars in Zeppelins, within the envelope itself as was the case in the L II.

Surgical Work of Aeroplanes in War.—Several interesting suggestions as to the uses to which aeroplanes might be put by the medical services in time of war were made by Lieut. Colonel J. D. F. Donegan, R.A.M.C., in the course of a lecture at the Royal United Service Institution, Whitehall. As regarded the use of aeroplanes for scouting for wounded on the battlefield, he could not at present realize their element of utility, but it was possible that at some future date aerial transport would simplify the duties of administrative medical officers on the field. The late Colonel Cody was deeply interested in the question of the provision of surgical assistance. From experiments made with both his machines, Colonel Cody and others were confident that it was perfectly possible to carry for long distances a specially designed operating table, with all surgical contents, and an operator, an assistant, and an anæsthetist, in addition to the pilot. Passing to consider the feasibility of his proposals, the lecturer explained that they were not for to-day or to-morrow. It would be quite time enough to consider the matter seriously when we were in possession of machines with the lifting power necessary to convey three officers, in addition to the pilot, provided that they were not at present available or in course of construction. The question of opposing forces objecting to aeroplanes engaged in medical work flying over their positions might be arranged amicably.

Fire-Proofing Aeroplane Fabric.—The object of fire-proofing a fabric of any kind is not the prevention of the charring or burning of the material but the prevention of the spreading of the flame which comes in contact with the fabric at any spot. It is better, therefore, to use the word "flame-proofing." For the flame-proofing of fabrics in general, there are two methods used, according to P. W. Litchfield, factory manager of the Goodyear Tire and Rubber Company. First, the impregnation of the fabric and the coating of the same with a non-inflammable mineral constituent, which must be either fused or mechanically broken away before the fiber can burn. Second, the presence of some salt, which, in addition to the above action, will give off some gas such as carbon dioxygen that displacing the oxygen, will prevent further propagation of the flame. There are three or more ways of carrying out this impregnation, one being the simple impregnation of the fiber with the mineral constituent as such; or, second, the use of such substances as glue, starch, dextrin, etc., as an adhesive for retaining the mineral constituent on the fiber, by first treating with a solution of such a compound as soluble phosphate, and then immersing in a bath of alum, whereby the insoluble aluminum phosphate is formed in the fabric. Coming to the fire-proofing of balloon fabric, it is more difficult because of the usual presence of rubber, which gives a new factor to the proposition. Here, perhaps, the presence, in the coating of compounds which liberate non-inflamable gases is more suitable than heavy loading of the fabric with mineral constituents which would increase the weight of the fabric and therefore be out of the question. There is, however, a difference in various rubber compounds as to the rapidity of flame spreading, due to the properties of the rubber itself and to the compounding and vulcanization.

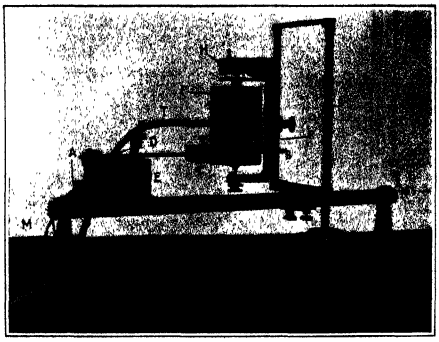


Fig. 1.—Calibrating apparatus of the vibrometer.

AB, vibrating rod, *E*, electromagnet; *R*, receiving capsule of vibrometer; *C*, sliding weight, *D*, regulating screw; *F*, cylinder; *H*, clockwork, *S*, supporting frame, *MN*, carrying bar

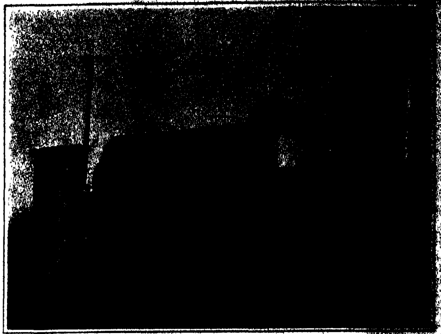


Fig. 2.—Registering cylinder, clockwork and registering capsule of vibrometer.

AB, starting cord; *ADC*, starting lever; *K*, cylinder; *I*, registering capsule with tracing stylus. (The clockwork is inclosed in the cylindrical case at the left.)

An Ingenious Instrument for Studying Vibrations

The Bourlet-De Guiche Vibrometer

By Jacques Boyer

THE Bourlet-De Guiche vibrometer is designed for the purpose of registering the frequency and amplitude of the vibrations or oscillations of solid bodies which not only vibrate, but also move in any manner in space. Among such bodies are the frames of automobiles in motion (Fig. 4) and the wings of aeroplanes during flight.

The ordinary registering instruments, which require fixed points of support in the vicinity of the vibrating bodies, are not suited to these cases, in which the registering apparatus must participate in the general motion and select the vibratory movement for registration.

The Bourlet-De Guiche vibrometer, which its inventors recently submitted to the Paris Académie des Sciences, solves the problem in a complete and satisfactory manner. The apparatus comprises two manometric capsules, connected by a rubber tube. To the flexible membrane of the first capsule, or receiver, is affixed a large and heavy metal disk. This capsule, which is attached to the vibrating body, with its membrane perpendicular to the direction of vibration, participates in the vibratory movement without appreciably affecting it, because the mass of the capsule is very small in comparison with that of the vibrating body, while the inertia of the metal disk impresses upon the membrane a relative and inverse vibration of the same *period as that which it is desired* to register. The variations of pressure thus produced in the receiving capsule are communicated through the rubber tube to the second, or registering, capsule, which resembles an ordinary Marey capsule, and is provided with a stylus that writes a trace of its movements on a rotating cylinder coated with lamp-black.

A summary calculation shows that the relative motion of the disk with respect to the receiving capsule is compounded of a principal vibration synchronous with the vibration to be registered, and a secondary vibration due to the elasticity of the membrane. MM Bourlet and De Guiche have constructed their vibrometer in such a manner that this secondary movement is entirely negligible. For this purpose they employ a thick, tightly-stretched membrane and a metal disk large enough to cover the whole of the membrane except a narrow annular margin. In these conditions calculation shows that, for a given frequency of vibration, the amplitude *a'* of the oscillations of the tracing point varies in proportion to the amplitude *a* of the vibrations which are to be measured, but that the ratio between these two amplitudes is a decreasing function of the frequency.

The following theoretical deductions have been confirmed by experiment: 1. The secondary vibration is absolutely negligible and usually imperceptible, so that the synchronism of the tracing point with the vibration to be measured is assured. 2. For given frequency the ratio between the amplitudes *a* and *a'* (the ratio of damping) remains constant when *a* varies. 3. This damping effect increases with the frequency.

Before the vibrometer can be used on a vehicle it must be calibrated in the laboratory. The calibrating apparatus (Fig. 1) consists essentially of a metal rod *AB*, fixed at the end *A* and kept in vibration by means of an electromagnet *E*. The receiving capsule *R* is attached to the free end *B* of the rod which [illegible] upon it a regular vibratory motion. The rod carries a sliding weight *C* by means of which the period of vibration can be altered, and the amplitude can be regulated by turning the screw *D* attached to the interrupter of the electromagnet. The vibrations of the rod are registered directly by a stylus on the cylinder *F* which is turned by the clockwork *H*. The whole apparatus, including the vibrating rod, the electromagnet and the cylinder with its clockwork *H* and its support *S*, is mounted on a horizontal bar *MN* of square cross-section, which can be turned about its axis in order to place the receiving capsule *R* in a horizontal or a vertical position at will.

The registering capsule *I* and cylinder *K*, with the clockwork that drives the latter, are shown in Fig. 2. When the cord *AB* is cast loose the lever *ADC* turns about *D* and the clockwork is released by the withdrawal of a stop attached to the end *C*. The clockwork runs light for a few seconds until the helicoidal clutch, which can be seen in the engraving beneath *C*, has become completely engaged. This device avoids irregularity in starting and assures uniform rotation of the cylinder.

Fig. 3.—Calibrating the vibrometer.

Fig. 3 illustrates the method of conducting a calibrating experiment to determine the damping ratio as a function of the frequency of vibration. After the receiving capsule has been attached to the calibrating rod and connected with the registering capsule by the rubber tube, the rod is set into vibration and both cylinders are started. In this way the vibrations of the rod and of the membrane of the registering capsule (and, if great precision is required, those of a tuning fork also) are registered simultaneously. The experiment is repeated many times, the amplitude of vibration of the rod being varied by means of the regulating screw and its period being changed by moving the sliding weight. The records made on the cylinder *K* (Fig. 2) give the period of vibration, either from the known rate of rotation of the cylinder or by comparison with the tracings of the tuning fork. Then, after comparison of the records on the two cylinders has proved that the amplitude of the registered vibration bears a constant relation to that of the original vibration, or the same frequency, this ratio is measured for various frequencies, and the measurements are incorporated in a curve or a table, from which the value of the ratio for any frequency, or period of vibration, can easily be deduced. The calibrated vibrometer may be used for measuring the vibrations of any moving body, and especially of automobiles and aeroplanes.

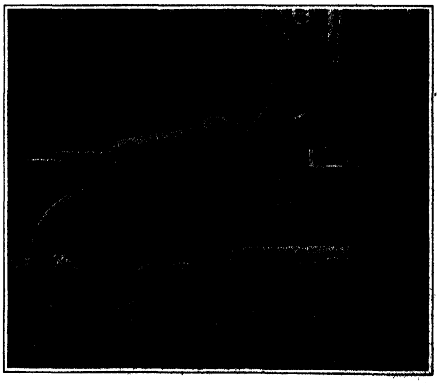
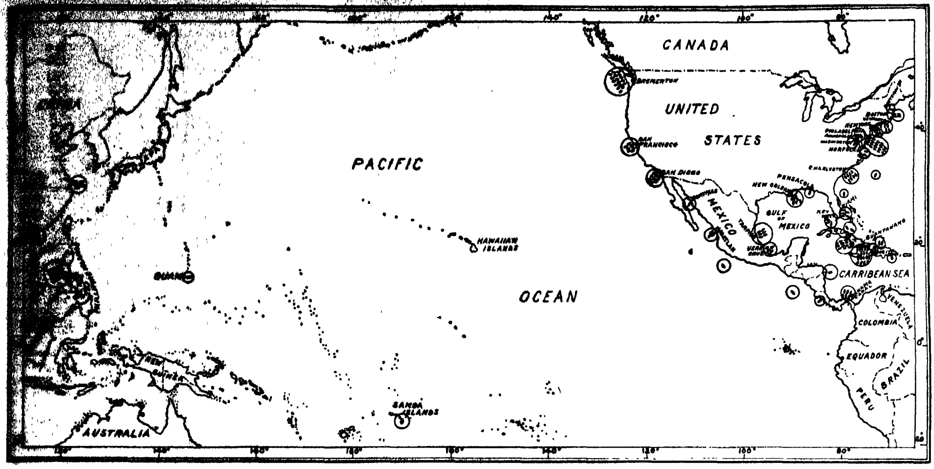


Fig. 4.—Measuring the vibrations of the chassis of a moving automobile by means of the Bourlet-De Guiche vibrometer.



Map showing disposition of ships of the United States Navy on February 12th, 1914.

The Problem of Our Navy

I.—How the Navy is Daily Employed

By Hon. Franklin D. Roosevelt, Assistant Secretary of the Navy

> *Modern naval wars start with all the surprise and destructive shock of an explosion of dynamite, as witness the Japanese destroyer attack which so seriously crippled the Russian fleet at Port Arthur before any declaration of war had been made. Modern naval wars are won when the battleship fleets meet and fight it out to a finish on the high seas; as happened later when Japan annihilated the Russian first line of battle at Tsushima. The navy of a great nation like the United States must be proportioned to the magnitude of that nation's international policies—to the distance from home and the area of the field in which it may be engaged in hostilities—and above all, to the size and strength of the first battleship line of those nations which may dispute by armed force that nation's policies. As matters now stand, the United States is endeavoring to support first-class policies with a third-class navy. Measured by the daring of our policies and the boldness with which they are being proclaimed, our fighting line of dreadnoughts is about one half as powerful as it should be. The navy, as it stands to-day, is short of men, short of torpedoes, has no comprehensive scheme of swift mobilization—has, in fact, no adequate reserve of men with which to mobilize; and in case of sudden complications with a foreign power over, say, the Monroe Doctrine or the Panama Canal, would find itself incapable of entering into a war with any hope of that quick success, which will be achieved by the nation that engages with a preponderance of dreadnought strength and the ability to mobilize its whole fleet in a week or ten days' time.*
>
> *These are some of the questions which we shall consider in the series of articles on "The Problem of Our Navy," of which this is the first.*
>
> *But the Navy, though deficient in quantity—in ships, officers and men—is absolutely first class in quality. That the nation is being well served, day by day, in these times of peace, is shown in the following very able article by the Assistant Secretary of the Navy.*—EDITOR.

A CERTAIN person of some prominence in public life, who should have known better, recently referred to the American Navy as an organization of "highly paid idleness."

In regard to the pay of the Navy, it is sufficient to dismiss the allegation with the statement that the average pay of all the officers and enlisted men in the service amounts to just $618 per annum apiece. But the use of the word "idleness" leads me to fear that there must be some people who are not familiar with the manner of occupation of the ships and men of the service in times of peace.

In my office in Washington hangs a map of the world, showing by means of pins the location each day of the ships of the Navy. This map is a constant source of interest and surprise to visitors, and any study of it leads to the inevitable conclusion that our vessels and the men who man them lead an existence of constant occupation and useful effort, that is surpassed by no other agency of the Government of the United States.

It so happened that on the 12th of February, 1914, all the ships of the Navy, with the exception of a small gunboat used as a station ship at Constantinople, were located between the longitude of Santo Domingo on the east and that of Canton on the west. Therefore the appended map includes only that portion of the earth's surface. It should be remembered, however, that only a few months ago we had battleships in the Mediterranean, cruisers in South American waters and in other places not shown on this map, and that it represents only the locations shown on the Department map on the day it happened to be copied for reproduction in the SCIENTIFIC AMERICAN. Every day of the year the pins are changed as the ships move on their never-ending duties.

Some of their occupations are self evident; but a short explanation of why each ship is in each particular place will perhaps in itself give a better answer to the question, "Why have we a navy?" than would a dozen long volumes on sea power or strategy. For the accompanying map shows both the strength and the weakness, the sufficiency and the crying needs of the American Navy to-day.

Starting with the Asiatic fleet, there are shown five light draught river gunboats on the Yangtse River in China and two near Canton, all of them used on a friendly patrol duty which has been going on for many decades.

To the southward concentrated in the Philippine Islands is the main body of the Asiatic squadron, consisting of the following vessels: Cruisers "Saratoga," "Cincinnati," "Galveston;" monitors "Monterey," "Monadnock;" 1 gunboat; 5 torpedo boat destroyers; 6 submarines; 4 auxiliaries—a total of 21 vessels which in time of peace is sufficient to guard the various American interests in the island and other parts of the Far East, but which in time of war against any important naval power would be practically a negligible quantity. For it goes without saying that cruisers, old monitors, and a few destroyers and submarines could not long withstand an attack by a modern battle fleet. The maintenance of these ships of small fighting value in the Far East is justified not as a war measure, but because American activities, not only in our own possessions but in all the neighboring seas and countries, require in time of peace the moral support of the ships' presence.

Moving eastward on the map our next vessel is seen at the island of Guam, serving as a station ship for the island government, which is conducted with conspicuous success by a naval officer. In fact, a comparison of conditions on that out of the way speck in the Pacific with those existing before American occupation, or even with those existing to-day in nearby islands under the rule of another power, shows a real accomplishment of which the Navy and the American people can be proud. The same statement can be made about our other Navy-governed possession of Tutuila, or American Samoa. Here also a gunboat is maintained as a station ship.

Turning now to the northern Pacific, it will be seen that no ships are stationed at Hawaii This is however, only a temporary condition, and the completion of the Pearl Harbor Naval Station will make this an important strategic base.

In Puget Sound is located the Pacific Reserve Fleet consisting of the following ships battleship, second line, "Oregon," armored cruisers "South Dakota," "West Virginia," "Colorado," cruisers "Albany," "Charleston," "Chattanooga," "St Louis," "Milwaukee;" 2 submarines; 5 auxiliaries These ships are maintained with skeleton crews, and while still serviceable in battle against enemies' ships of equal age, would have small military value against a more modern fleet. In addition to these, a submarine recently completed is being placed in commission at Puget Sound

In San Francisco Bay are the cruisers "Cleveland" and "Marblehead" (in reserve); 1 gunboat; 4 submarines; 4 torpedo boat destroyers (in reserve); 2 torpedo boats (in reserve); 2 auxiliaries. It may here be noted that the necessity for the presence of ships in Mexican waters and for other important duties makes it highly undesirable to keep so many ships on the Pacific Coast in reserve, but the lack of sufficient officers and men to place them in full commission makes any other course impossible; and this in spite of the fact that the quota of men allowed is at present up to the legal limit.

Near Santa Barbara and San Diego, California, 5 torpedo boat destroyers with a parent ship are engaged in their annual maneuvers and torpedo exercises Two submarines with an attendant monitor are also engaged in their practice drills in this vicinity, and the armored cruisers "Maryland" and "California" are holding their usual winter target practice All of this work corresponds to the drills of the Atlantic fleet in West Indian waters each winter, but the shortage of men and the unusual international requirements have of late prevented the carrying out of these exercises in the manner the Department would like to see.

Farther south on the west coast of Mexico are found the armored cruiser "Pittsburgh," cruisers "Raleigh" and "New Orleans," 1 gunboat and 1 auxiliary. The reasons for their presence in these waters require no comment.

Still farther south the cruiser "Denver" is proceeding to relieve the transport "Buffalo" at Corinto, Nicaragua, where for some time the State Department has considered the presence of an American warship desirable. This completes the list of ships in the Pacific Ocean. They seem formidable in numbers, and they are doing valuable work of almost every conceivable kind, but as a fighting force against a modern fleet they must not be highly estimated

In the Atlantic Ocean is found both the greatest numerical and the chief military strength of the Navy. Far to the north in the Gulf of St. Lawrence, but not shown on the map, the naval tug "Potomac," bound on an errand of mercy to rescue the crews of American fishing boats, has herself been caught in the icefloes and at this writing is in grave danger of destruction. At Portsmouth, N. H., the cruiser "Tacoma" is undergoing repairs. At Boston the second line battleship "New Jersey," recently from Mexico, is being overhauled; the armored cruiser "North Carolina" and the cruiser "Chicago" are in reserve, and a new submarine is being placed in commission. At Newport 4 old torpedo boats are maintained in reserve and a submarine is being fitted out.

At New York the first line battleship "North Dakota" is repairing; the first line battleship "Arkansas" is in quarantine with a few cases of illness on board; the armored cruiser "Washington" is used as a receiving ship; a gunboat is in reserve, and a monitor and submarine are preparing for the formation of a new submarine division.

At the Philadelphia Navy Yard are the cruiser "Montgomery," 2 destroyers in reserve, and a submarine fitting out; and here also are stationed the ships of the Atlantic Reserve Fleet, as follows: Second line battleships "Idaho," "Maine," "Missouri," "Alabama," "Illinois," "Kearsarge," "Kentucky," "Wisconsin," "Indiana," "Iowa," "Massachusetts;" the armored cruiser "Tennessee," the cruiser "Salem" and repair ship "Panther" As in the case of other ships in reserve, they are from the military point of view valuable for fighting purposes only against ships of an equal or greater age. That it would amount to little less than murder to send American officers and men out in these old ships to fight against a fleet of modern dreadnoughts is a simple truth that everyone should understand. These ships have still a possible use; but to place reliance on them in a time of crisis could never be warranted

At the Naval Academy at Annapolis are stationed 5 torpedo boats, and at Washington two converted yachts. In the Norfolk Navy Yard the second line battleship "Vermont" is undergoing repairs to the shaft broken while returning from the Mediterranean, and the monitor "Tallahassee" is being used for ordnance experiments Off Cape Hatteras the first line battleship "Michigan" is proceeding south to join the other ships of the second division at Guantanamo.

Charleston, S. C., is the regular base of the torpedo boats and destroyers in reserve, but only 5 of the former and 3 of the latter, together with 1 submarine, are there at the present time. The rest of the reserve destroyers, 6 in all, are on the coast of Florida engaged in their annual practice cruise for a period of two months These vessels are manned by only half crews, but are kept on the whole in an efficient condition and are not obsolete At Key West three new destroyers recently placed in commission are engaged in "shaking down" trials and in torpedo practice preliminary to taking their places with the Atlantic fleet In Pensacola Bay the second line battleship "Mississippi" is being used in experimental aeronautic work At New Orleans the monitor "Tonapah" and the second submarine group of 5 vessels are engaged on the annual practice cruise.

Off the north coast of Cuba the "Prairie" and "Hancock," transports, are returning with two regiments of marines from a month of "advance base" maneuvers on the island of Culebra, just east of Porto Rico. This work consists, as the name implies, in landing and fortification drills with the object of establishing a base on a hostile shore

South of Cuba all the ships of the Atlantic fleet, except those in Mexican and Haitian waters, are engaged in the regular winter practice work—fleet and division drills, torpedo and target practice, boat drills, etc. At Guantanamo Bay are the following ships: Second line battleships "Louisiana," "Kansas," "New Hampshire;" cruiser "Birmingham," 1 gunboat and 12 torpedo boat destroyers.

A little farther to the west, near Guacanaybo Bay, Cuba, are the rest of the ships of the Atlantic fleet, engaged in similar practice: First line battleships "Wyoming," "Delaware," "Florida," "Utah," 6 torpedo boat destroyers, and one destroyer tender.

The island of Haiti has recently required the almost constant presence of one or more American ships. At Santo Domingo city is the gunboat "Petrel." Off the coast of Haiti are the battleship "South Carolina," the armored cruiser "Montana," the cruisers "Nashville" and "San Francisco," and the surveying ship "Eagle." The "Montana" was engaged in torpedo training exercises and the "San Francisco" in mine laying practice off the Cuban coast, but both were hurried to Haiti on the outbreak of the revolution there.

On the east coast of Mexico, performing an obvious duty, are the following ships: At Tampico: Second line battleships "Rhode Island," "Georgia," "Nebraska," "Virginia," cruiser "Des Moines;" and 1 gunboat. At Vera Cruz: Second line battleships "Connecticut," "Ohio," "Minnesota," and cruiser "Chester." Off the coast of Honduras the auxiliary "Hannibal" is engaged in hydrographic surveying. Finally, at Cristobal, the Atlantic end of the Panama Canal, are 5 submarines and their "mother" ship the gunboat "Severn."

I regret that it is impossible in this short article to describe in detail the daily life of the officers and men on board all these ships in both oceans Ask any of them and they will tell you that there are few moments for idleness, that the many duties require constant mental alertness and physical fitness, and that the man who wants to succeed has in the service to-day a field of opportunity greater than ever before.

Such was the disposition of the American Navy on the 12th day of February, 1914. Briefly, it shows that in times of peace it is as an organization very much occupied with many different kinds of work in many different places; that it is keeping the peace, preventing bloodshed and disorder, governing islands, carrying on scientific work for the benefit of commerce, seeking to rescue castaways, and doing daily a hundred unsung deeds that make it an American institution to be proud of.

But there are other facts to be deduced also—facts based on the premise that the primary object of the Navy is to be ready in the unfortunate event of war To this end all others must of necessity be subordinated. Just as the police force of a city is of little value in stopping the invasion of a country by a foreign force, so the work of the gunboats and surveying ships and obsolete battleships in time of peace would count for little against the enemy's fleet in time of war. The day is past when it was possible to build, equip and man a frigate in six months. Now a battleship which takes three years to build cannot be taken into an engagement by any kind of officers or any kind of a crew. Many months of thinking, toil and practice are necessary to efficient maneuvering and straight, quick shooting.

A naval war of to-day would not see single ships in action, nor would it see a fleet divided and scattered along the two coasts of the continental United States. A glance at the map shows a part of our activities and interests outside of this continental portion in time of peace. Would we then in time of war be content like the turtle to withdraw into our own shell and see an enemy supersede us in every outlying part, usurp our commerce and destroy our influence as a nation throughout the world?

Yet this will happen just as surely as we can be sure of anything human, if an enemy of the United States obtains control of the seas And that control is dependent absolutely on one thing—*the preponderant efficiency of the battle fleet.* A thousand gunboats, a thousand harbor-defense submarines or monitors would avail us nothing. Invasion is not what this country has to fear. If the American people are willing to be relegated to the position of a nation unimportant in the great affairs of the world, without influence in commerce, or in the extension of peaceful civilization and high ideals throughout the world, they need no battleships, they need not fear the loss of control of the seas.

Students of naval warfare, naval officers, historians, are as a whole as desirous of peace as any class of Americans; they deplore the struggle of the nations to guard themselves with military preparations, but they realize that we are confronted with a fact and not a theory. The day will come, they hope, when armaments will be limited by international agreement, and they are ready to help hasten that day. But until that day is an assured fact the American Navy must keep the principles of a possible naval conflict always in mind. The efforts of all must be concentrated, as far as possible, on the preparation of the battle fleet. That fleet must at all costs be kept together, for division of forces is fatal; it must be drilled and maneuvered; it must spend good money for target practice; it must contain the best material and the latest devices; and it must in its personnel typify the highest ideals, the greatest efficiency of American citizenship.

Sir David Gill

SIR DAVID GILL, the eminent astronomer, died in London on January 24th in the seventieth year of his age. He was educated at the University of Aberdeen, and spent the time between his twenty-fifth and thirtieth years in preparing himself to be an [illegible] at a private observatory in Aberdeen. During [illegible] three years, 1873 to 1876, he directed the [illegible] servatory of the late Earl of Crawford, then [illegible] say, and organized the Lord Lindsay [illegible] Mauritius to observe the transit of Venus, [illegible] vations being undertaken with a view to a [illegible] tion of the distance of the sun, a problem [illegible] a lasting interest for Sir David, and to which [illegible] constantly returning.

From the measurement of the distance of the [illegible] turned to the measurement of the earth. [illegible] same three years he connected the longitudes of [illegible] Malta, Alexandria, Suez, Aden, Seychelles, [illegible] and Rodriguez, and measured the baseline [illegible] geodetic survey of Egypt, near Cairo. This [illegible] first step toward realizing what he called the [illegible] his life, namely, the measurement of the great [illegible] arc of the earth on the thirtieth meridian.

In 1880 he proposed the geodetic survey of [illegible] Cape Colony, although the project was not [illegible] completion till sixteen years later. He lived [illegible] gap in the arc between Rhodesia and the [illegible] up and its subsequent extensions through [illegible] Africa, along Lake Tanganyika, toward the [illegible] When that work is altogether completed the [illegible] will join that of Greece and Struve's great [illegible] terminates at the North Cape, and will be the [illegible] length of the world's surface, 105 deg., more [illegible] miles, to be measured with mathematical accuracy.

But before this, in 1877, he proposed and carried out an expedition to Ascension Island to determine the solar parallax by observations on Mars, and in [illegible] he was offered the post of Astronomer Royal at the Cape of Good Hope. He continued his work along the lines of solar parallax determinations, organizing transit of Venus expeditions to this end.

In 1882 a great comet became visible, and Sir David, with the assistance of an intelligent Cape photographer, succeeded in obtaining some beautiful pictures of the comet, the camera being strapped on the telescope, and not only of the comet, but of the surrounding stars. They were the first really fine photographs of a comet, but they were also the first of the modern photographic star-plates, and from these photographs sprang the whole project of the great Star Map, which still engages the observatories of the world. From this also originated the new method of determining the sun's distance by photographic observations of the minor planet Eros. The spirit which inspired Sir David Gill in his work is best described in an extract from his presidential address to the British Association in 1907:

"Accurate and minute measurement seems to the non-scientific imagination a less lofty and dignified work than the looking for something new. But nearly all the grandest discoveries of science have been the reward of accurate measurement and patient long-continued labor in the minute sifting of numerical results."

He was the recipient of numerous honors, among others being the F. R. S. and K. C. B.

International Map of the World

THE second international conference on the "millionth" map of the world (Carte internationale du monde 1: 1,000,000) met in Paris, December 10th to 18th, 1913, and was attended by representatives of thirty-four countries. Although the fundamental features of this chart were settled at the original conference, in London, many special problems have arisen, and these the second conference attempted to solve. Specimen sheets of the chart have already been prepared by Great Britain, France, Spain, Italy, the United States, Japan, Mozambique, and Sweden. At the London meeting it was decided to include on the chart place-names in common international use in addition to the official names used in the several countries. The Hungarian delegation at Paris endeavored unsuccessfully to have all but the official names eliminated. In the discussion on this subject Prof. Partsch pointed out that the world at large would hardly recognize Jerusalem and Damascus under their official names of El-Kuds and Esh-Shâm, respectively. An additional argument in favor of retaining customary international names is that official names are subject to change with changes of sovereignty (as, for example, after the recent war in the Balkans). It was decided to establish permanent headquarters for the undertaking at London and Southampton. The next conference will be held in Berlin toward the end of the present year.

The "Limequat."—This portmanteau name has been applied to a new hybrid, obtained by crossing the West Indian lime with the kumquat. The tree is much hardier than the lime, having withstood the past three winters in extreme northern Florida, where the lime cannot be grown. Fruit was obtained for the first time during the past year, and proved to be much like the West Indian lime in size and flavor.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Possibility of Utilizing Power From the Sun

To the Editor of the SCIENTIFIC AMERICAN:

I read with much interest an article in your SUPPLEMENT of January 31st, 1914, entitled, "Energy Sources of the Future."

In this article you say: "The capture (of the sun's heat) has been attempted, but on a very small scale and by an ineffective method. The sun's rays have been made to furnish mechanical energy by generating steam in boilers. This method involves great losses, and is incapable of high efficiency."

We have experimented during the past seven years on a *very large* scale with sun power, and have brought sun power from the ideal stage into the real. Our sun power plant at Cairo has been tested by well known independent engineers, and inspected by many engineers and scientists. Lord Kitchener and Sir Reginald Wingate have watched its working and invited us to put up a similar plant in the Soudan.

Every figure I am going to give is based upon actual results already obtained. There is not a single "should give" or "guess" about it. Sun power is now a fact, and is no longer in the "beautiful possibility" stage. It can compete profitably with coal in the true tropics *now*.

Sun power has a history something like aerial navigation. Up to twelve years ago it was a mere possibility and no practical man took it seriously. The Wrights made an "actual record" flight and thereafter developments were rapid.

We have made an "actual record" in sun power, and we also hope for quick developments.

The steam boiler has had a hundred and fifty years time for evolution and has reached an efficiency during all this time of only 75 per cent at best.

Our method of generating steam from the sun's rays has had only seven years' time for evolution and has already reached an efficiency of 57 per cent.

Surely this, considering the youth of sun power, is not to be described as "incapable of high efficiency."

Our sun power plant of the vintage of 1911 turned 43 per cent of the heat of the sun which reaches the earth's surface into steam, and our present plant tested during the end of August, 1913, turned 57 per cent into steam, an improvement of 14 per cent in two years' time. This record should certainly encourage us in thinking that during the next ten years we shall be able to reach the 75 per cent efficiency of the best modern steam boiler, and thereafter possibly surpass it.

I will now give a few figures which I stand ready to prove from actual results, as to how safely the human race can lean on the heat and power from the sun's rays, when this heat is turned into steam (surely the most direct and logical way of utilising it).

These figures are based on the results actually secured at Cairo, Egypt, in latitude 30 degrees north, by no means yet on the equator, where results would still be better, and on what *has been done*, and not what is going to be done.

For the purpose of my calculation I have taken as a basis the figure given in your article of two hundred and seventy million horse-power continuously throughout the year being equal to all the coal and oil mined during the year 1909 throughout the world.

Now, our sun heat absorbers at Cairo occupy less than an acre of room and develop 50 brake horsepower throughout a ten-hour day. This does not mean that an acre of sunlight is intercepted. The area of sunlight intercepted is only 13,269 square feet, or less than one third of an acre, but it is necessary to place the heat absorber units sufficiently far apart so that they won't shade each other in the early forenoon and late afternoon.

Taking the above actual work of our plant as a basis, it would only be necessary to cover 20,250 square miles of ground in the Sahara Desert with our sun heat absorber units, spaced as wide apart as they now are, to give *perpetually* the two hundred and seventy million horse-power per year required to equal all the fuel mined in 1909.

This area of 20,250 square miles is practically equal to a square of 143 miles, and its size as compared with the Desert of Sahara is shown by the accompanying map. Surely from this showing, the human race can see that sun power can take care of them for all time to come.

Now the next question your reader will ask is, "How much will it cost to do all this?" Of course the figure will be staggering, being equal to ninety-eight and one half billion dollars ($98,500,000,000).

An independent engineer with long experience in power plant building in the tropics, estimates the cost of construction and erecting the 50 horse-power sun heat absorbers referred to above at $7,600, and by ordinary proportion we obtain the figure given above. Surely this is safe, because in the hundred odd years or so required to totally exhaust our fuel store there will be great developments in sun power.

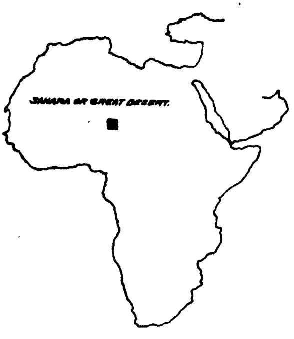
Having planted the desert with sun heat absorbers at a cost of ninety-eight odd billion dollars, let us look at what we have secured at this enormous cost, and let us see whether we have made a good investment.

We will then have a plant that is worth to us at least as much as all the coal and oil fields in the whole world; because it can *perpetually* give us as much heat and power as all of the coal fields and oil fields of the world put together, if mined at the 1909 rate. And these are certainly worth very much more than ninety-eight odd billion dollars.

This vast investment would not be made for or by the individual, but for and by the entire human race, and we may safely assume the human race to survive all the coal and oil fields by many thousands of years. Hence, its overwhelming value of perpetuity and its capacity for practically infinite expansion.

The wear and tear and depreciation of sun power plants is no greater than that of coal or oil consuming plants, and another advantage is that the heat is delivered into the boilers entirely free of all cost. All the tremendous costs of mining and transportation and dangers to life are avoided.

To the individual, ninety-eight billions is a staggering sum, but to the human race, particularly if spread out through a period of say 200 years, it is *almost nothing*.



This map shows how very little of the Great Desert of Sahara would have to be covered with sun heat absorbers to obtain *every year* a heat value equaling that of all of the coal and oil mined in all the world during the year 1909

The human race has expended in coal mines and oil mines and boiler and heating plants many times that sum during the last hundred years alone.

We feel sure the greatest developments in sun power will come when the minds of many thousands of thinkers will be turned in this direction, by the results of our work. We do not expect to do it alone, all we shall now do is to establish sun power as a commercial rival of coal in those portions of the true tropics where coal is very expensive and the sun is very powerful. This will result in enormously increasing the area of cultivatable land, and we will rest at this for the present.

One thing I feel sure of, and that is that the human race must finally utilize direct sun power or revert to barbarism, and I would recommend all far-sighted engineers and inventors to work in this direction to their own profit, and the eternal welfare of the human race.

Tacony, Philadelphia. FRANK SHUMAN.

The Four-cylinder vs. the Six-cylinder Car

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of January 3rd, page 10, under the heading "The Car of 1914" we find this statement:

> "The six cylinder car is predominant. From a small beginning it has swept on until in 1914 it has well nigh carried all before it. *It is the prevailing feature of the past automobile year* beside which other features pale; but not into insignificance."

We are inclosing a tabulation of the exhibitions at the recent auto shows in New York. While this does not necessarily settle the question, it is at least significant.

Your contributor made no distinction in his article; he bluntly said, "The six-cylinder car is predominant."

We feel at liberty therefore to answer it on the same basis.

While the number of makers producing "sixes" has probably increased by what may look like a big percentage, the increase in the actual quantity of six-cylinder cars produced is not relatively large.

There are at least two, and we believe four makers, any single one of whom is producing more four-cylinder cars than all the six-cylinder cars combined.

Now pardon us if we mention the Cadillac. We have already shipped more than 7,500 of the 1914 models.

We would not be surprised if this nearly equaled the output so far of all 1914 six-cylinder cars combined. It certainly exceeds the combined output so far of all six-cylinder cars which are generally recognized as being high grade or even those selling at or above the Cadillac price.

Taking the proposition as a whole, we find according to estimates which are as authoritative as such estimates can be, that the number of cars which have and which will be produced during the 1914 season will be eight to ten four-cylinder cars to one six-cylinder car.

On the basis of dollars and cents, these same estimates show that the selling value of the fours will be two to three times the value of all the sixes.

The fact is, the six does not even approach the four, whether you figure on the basis of the quantity of cars produced or the value of the product.

This letter is dated January 19th, at which time more than 7,500 1914 Cadillacs have been shipped.

Detroit, Mich. CADILLAC MOTOR CAR COMPANY,
By K. P. DRYSDALE, *Advertising Manager.*

Dividing United States Coins

To the Editor of the SCIENTIFIC AMERICAN:

I give herewith a solution of the problem in United States coins, given by Theodore L. DeLand on page 117 of your issue of February 7th:

22	coins of	$20.00	each	$440.00
4	" "	10.00	"	40 00
1	" "	5 00	"	5 00
4	" "	2.50	"	10 00
6	" "	.50	"	3 00
1	" "	.25	"	25
1	" "	.10	"	.10
1	" "	.05	"	.05
160	" "	.01	"	1.60
200				$500.00

New York city. FRANCIS J. HALL

To the Editor of the SCIENTIFIC AMERICAN.

In the correspondence column of your issue of February 7th, Mr. Theodore L. DeLand wants to know how two hundred United States coins can be divided so as to total five hundred dollars. Given below are three solutions:

(1)	6	$20.00	$120 00
	4	10 00	40 00
	10	5 00	50 00
	110	2.50	275.00
	16	.50	8 00
	18	.25	4 50
	22	10	2 20
	4	.05	20
	10	01	10
	200		$500 00
(2)	6	$20 00	$120 00
	6	10 00	60 00
	8	5 00	40 00
	110	2 50	275.00
	2	.50	1 00
	2	.25	.50
	20	10	2 00
	26	05	1 30
	20	01	20
	200		$500 00
(3)	2	$20 00	$40 00
	8	10.00	80 00
	10	5.00	50 00
	130	2.50	325 00
	2	50	1 00
	4	.25	1 00
	20	.10	2 00
	19	.05	95
	5	01	05
	200		$500.00

Kingston, N. Y. E A VIGNES

The Earthquake Felt at Troy

To the Editor of the SCIENTIFIC AMERICAN:

I write to report an earthquake at Troy, N. Y., on February 10th, which lasted from 1:30 P. M. to about 1:31 P. M. The quake was strong enough to cause loose articles to rattle and was distinctly noticeable to a person sitting down. The vibration was much like that caused by an engine on a boat.

Troy, N. Y. JOHN WILLIAM BACON.

A Triumphant Struggle With a Beetle

How the Cocoanut Trees of Samoa Were Saved

By H. J. Moors

THE value of cocoanut products has increased at a wonderful pace during the past five years, and the acceleration during the past two years has been quite phenomenal. This is chiefly owing to new methods of treatment and manipulation as applied to copra.

Cocoanut oil when made from the best materials is clear white and has a sweet, agreeable, nutty flavor. It is now possible to refine, clarify, flavor, and congeal this substance into a very useful butter, and numerous factories in Europe and also some in the United States have worked up such profitable business, that some of them last year declared dividends exceeding 40 per cent.

The demand for first-class copra is continuous and increasing, and the supplies though very large are still far below the demand, which every month enhances.

Many planting companies have been formed in Great Britain and in Germany, and very large groves of cocoanuts have been set out in many parts of the tropical world, but even if all of these were in fullest bearing, their output would hardly depress the market, so strong is the demand for this edible oil.

The cocoanut tree grows only from the mature nut, which is planted about six inches in the ground and not entirely covered up. Six years later the growing tree begins to deliver its fruits, a little at first, then more and more, until the twelfth year, when in good situations it delivers from 70 to 100, even up to 150 nuts per annum, each producing from one third to one half pound of dry copra.

About 50 nuts are planted to the acre and these give from one third to one half ton of copra which is worth to-day in the United States and in England about $160 per ton.

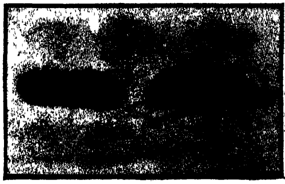
Fine grasses are grown beneath the trees in some parts, and great herds of fat cattle are raised for consumption.

As the cost of manipulating a cocoanut plantation is very little when it is in full bearing, and stocked with cattle, it can well be conceived that such property is highly valuable, and is held at prices ranging from $200 to $300 per acre.

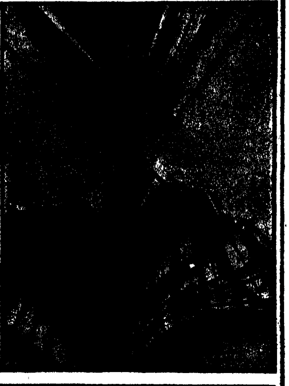
About 50 years ago, a vicious beetle appeared in Madagascar, and attacked the crowns of the trees, boring deep galleries right through the leaf stems into the heart of the cabbage. When these insects confined themselves to attacking the tree pretty high up, they did no very serious damage, though they ruined its graceful appearance. If they attacked low down, or deflected their course downward after entering, then they very frequently killed the trees. These insects range from an inch to an inch and three eighths in length; they are very thick and are armed with a formidable horn, from which they take their name.

Grove of cocoanuts taken from a balcony in *Apia. These were all in a fair way of dying,* but were saved by natives climbing them and removing the beetles with sharpened wires. Afterward the hunt for larvæ in this neighborhood become so keen that the trees were not attacked again.

Old cocoanut leaf branch, showing the tunnels through which the beetles entered.



Cocoanut or Rhinoceros beetle and larvæ.



Showing the beetles' work at close range.

Finis.

A TRIUMPHANT STRUGGLE WITH A BEETLE

They have done immense injury all over the tropical world, especially in Malaysia, Madagascar, Ceylon, the Philippines and Cochin China. About four years ago they first appeared in German Samoa, but little notice was at first taken of them. Later on, their destructive work attracted attention, and then alarmed the foreign residents.

Rewards were offered for the live beetles, and for their larvae, and after some $10,000 was paid out in a few weeks, the government had to change its policy, and to compel all natives to hunt beetles for about three hours each week for their own protection, while the foreign residents contributed liberally in cash for the abatement of the nuisance. Of course, such efforts had their effect, but the plague seemed to spread fast in all directions before the prevailing wind. In due course fully 20,000 trees were killed outright, and probably ten times as many are still beetle-infested and many will die.

The beetle lays its eggs frequently, and always on the ground, in the midst of rotting rubbish, if possible, rotting wood being a favorite place. It was found that if shallow pits were dug, say six by six, and a foot deep, and these filled up six or eight inches with rotten stuff, and a heap of cocoa shells piled on top, and the whole covered up with the soft soil that was first taken from the pit, a first-class beetle-breeding place had been provided.

It is likely that the smell of the fermenting and decaying cocoa shells drew the mother beetles from all directions. At any rate, they came to these "Tumus," and laid their eggs, and every ten weeks these "Tumus" were opened, and the larvæ and loose eggs were taken out and scalded. By this means probably millions of beetles never reached the harmful stage. These efforts were of great value, but something more was wanted, for the plague increased and many acres of fine cocoanuts were devastated. At last an experienced entomologist was sent for, and young Dr. Fredericks came out from Berlin. Month after month the residents of Samoa impatiently awaited results.

Feeling that more scientific help might perhaps find a way to limit the evil, private subscriptions were set afoot and Dr. Doane, of the Leland Stanford, Jr. University, was induced to come to Samoa during his summer vacation, and he and Dr. Fredericks worked in complete harmony.

But as Dr. Doane's stay was limited to seventy days, he had not sufficient time to do very much.

During the investigations, Dr. Fredericks noticed on one single beetle larva two small brown spots on its back; in a few days these coalesced and became one, and the larvæ sickened. Minute observation showed that it had been attacked by an island fungus. Other larvæ were confined with it, some twenty or more, and several of these were soon infected. But for many weeks the

(*Concluded on page 186.*)

"White Art" and the Automobile Leap at the Hippodrome

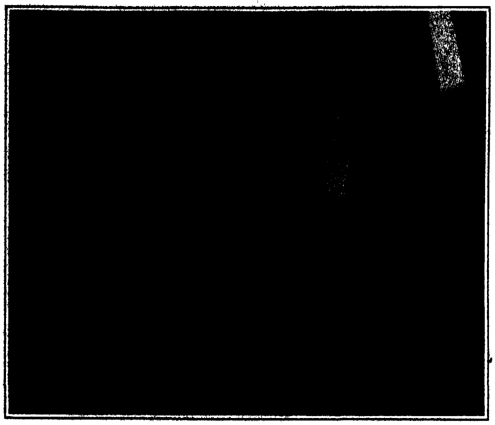
Phosphoresence by Irradiation

THE New York Hippodrome far outclasses its London namesake, and in the past nine years nearly 27,000,000 people have passed its doors. Each year presents novelties which are of great interest, and on two other occasions we have shown some unique features. This year two new acts are given which are certain to interest all readers of the SCIENTIFIC AMERICAN. Through the courtesy of Mr. Arthur Voegtlin, who has been responsible for the remarkable scenic effects in this vast house for many years, we are enabled to present authentic pictures of "white art," posturing as we might term it, in contradistinction to "black art," where the actors are clothed in somber mantles and perform on a dark stage. We might go a step farther and call it "luminous white art," for the girls would not give the realistic ghost-like thrills when they walk down the aisles if they did not wear phosphorescent garments.

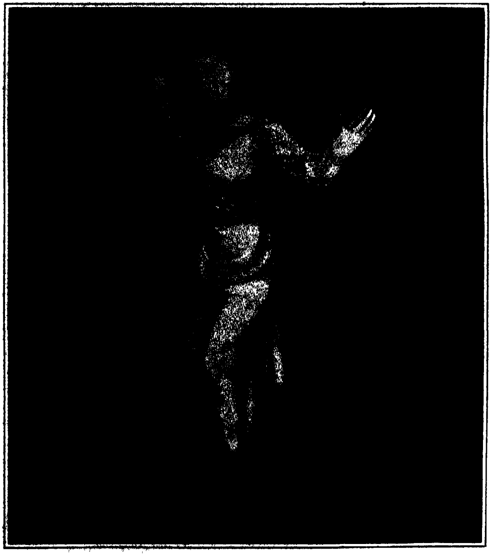
It might perhaps be well to glance for a moment at the principles which underlie all luminous preparations. A curious circumstance is that light from what we call phosphorus is not true phosphorescence at all, because it is accompanied by quite appreciable heat and is caused by slow combustion. It proceeds from the vapor of the phosphorus undergoing slow combustion. The term phosphorescence would best be applied only to cases in which no heat is appreciably evolved and no oxygen appreciably absorbed. The "luminous paint" phenomena belong to what is known scientifically as "phosphorescences by insolation or irradiation," giving out light in the dark after exposure to sunshine, the light of burning magnesium or the electric arc light. It appears that when certain rays of light fall upon a phosphorescent substance a change is caused and the rays are transmuted into others. In other words, the storage battery might be cited as a similar instance where chemicals are used to store up a potential force. The light which is stored in the phosphorescent substance is vitiated and in time exhausted when exposed in the dark.

In the Hippodrome during a "spooky" act the lights in the house suddenly go out and down the aisles come girls clothed entirely in white luminous garments, even to masks, headgear and gloves. They move up and down the aisles gracefully posturing like dancers to the mystification of the audience. People often put out their hands to touch the ghosts to see if they are real. After a minute or so the girls retire and assume their long black cloaks and they would hardly be noticed in the foyers. To be successful the house must be as dark as "Chevreul's black;" this is accomplished by the ushers momentarily masking the exit lights. The effect is most mysterious, as will be seen by our engraving.

A short time before the act the girls go to dressing rooms on the orchestra and balcony levels, and assume the luminous garments. Their faces are completely masked and they wear smoked goggles to protect their eyes while their garments are being charged. About 20 minutes are required to fully saturate the luminous coating. They turn around and bathe in the light so that every portion of their clothing is impregnated by it. Afterward comes the "cue" and the electrician turns off the switch and the girls move to their stations, where the ushers divest them of their cloaks, and they proceed down the aisles. It is a very pretty conceit and is exceedingly well done.



Charging the luminous garments with light emanations from an electric arc light.



"White art" weird ghost girls pass down the aisles dressed in phosphorescent clothing.

In the next scene we have the Grand Cañon of the Colorado River portrayed as well as it can be by the scene painter's art. The stage is divided into two parts by a great proscenium arch. To the front of this is the "apron" with its platforms covering the unique feature of the Hippodrome—the tank. While the tank is being filled, a short operation, the scene shifters are bringing out and lashing together three sections of roadway 79 feet long, which extends from the up-stage end to the edge of the tank. These elevated sections are strongly braced to stand the shock of the automobile in its spectacular descent. Mr. Voegtlin tried countless experiments with models before the exact angle of the track was determined. It was found by trial that the wheels need not be fixed and that the machine could be steered like an ordinary automobile.

Then came the call for volunteers for an actual test, for the use of dummies would have proved nothing. Finally one of the engineering staff, a man of extraordinary nerve, stepped forward and offered to pilot the machine With bated breath the technical staff waited to see whether he would land in the tank or in 6, 7 and 8. Fortunately he got clear and jumped at the right time and the trick was turned, but a new automobile was required for the next trip After about five automobiles were converted into junk, a special property auto was made of angle iron and it still stands the twice-daily ordeal. The run-way is banked so as to prevent the wheels leaving the track.

The car has weights secured in the back and there is a hump at the end of the track which serves to throw the car up so that it turns a complete somersault, landing in the water bottom side up. The tank is filled to 14 feet for this act and a tell-tale makes sure that the men will land in deep water when they jump The men swim under water and are seen on the surface as the curtain rises (it does not lower at the Hippodrome).

Some Well-packed Eggs

THE somewhat unusual feat of shipping eggs from one side of the world to the other was recently accomplished when a consignment from Russia arrived at Pittsburgh without a single one being cracked or broken. This shipment consisted of fifty cases, or 6,000 dozen, and originated at Warsaw The eggs were carried by boat to Labava, a distance of 1,400 miles, thence 1,500 miles by rail to Rotterdam, about 3,000 miles across the Atlantic to New York and 500 miles by rail to Pittsburgh The distance traveled was about 6,400 miles, and the eggs were drayed on a number of occasions, transferred from boat to rail and *vice versa* The cases were stood on end and with chains wrapped around three or four cases in a bunch they were lowered into the hold of the vessel and, in general, were subjected to much rougher handling than is encountered by shipments in this country

The cases in which these eggs were packed were 70½ inches long, 22 inches wide and 9½ inches deep, and were made of pine The ends were ⅞ inch thick and the top, sides and bottom ½ inch, the strips being 6 inches wide. In packing the eggs the case was laid flat and the packer took shavings and made a cushion, which was about 1 inch thick when packed close On top of the cushion the eggs were placed in 10 rows of 18 each, or a total of 15 dozen in each compartment layer. He then placed another cushion of shavings of the same thickness on top of this and then another layer of eggs, repeating the process until the filled case contained four layers. It is stated that the case and the shavings can be provided more cheaply than four of our standard cases with fillers of the same combined capacity.

A Monument to Capt. Robert F. Scott has been erected on the Col du Lautaret, France, in the Alpine garden of the University of Grenoble, where Scott spent some time mountaineering in 1908, in preparation for his Antarctic expedition. The monument is in the form of a polar cairn, ten feet in height, and bears a suitable inscription. It was erected by Scott's French admirers, on the initiative of Dr. J B. Charcot.

The Heavens in March

Is Interstellar Space Transparent? Are There Dark Nebulæ?

By Henry Norris Russell, Ph.D.

AMONG the recently published astronomical papers have been some of great interest which deal with the question whether interstellar space is transparent. We ordinarily assume that the light of the stars, even though it may have hundreds of years to travel before it reaches us, suffers no further loss in its passage than that which naturally arises from the spreading out of its waves over an ever-widening area. But within the last few years, this hypothesis (for it is no more) has been called in question by several investigators, and for different reasons.

If interstellar space was absolutely empty of matter, we know of no reason why light should be absorbed in passing through it; though he would be a bold physicist who claimed that we know enough about the ether to be sure that no such absorption could take place. But it is very improbable that interstellar space is so absolutely barren. There may be a good deal of matter floating about in it, perhaps in the form of solid lumps or particles of different sizes, perhaps as separate molecules of gas, and such matter, if it exists, would make the space within which it lay imperfectly transparent, acting like a very thin mist or fog.

The behavior of such absorbing material would, however, be different, according as it was composed of relatively large particles, or of material of molecular fineness. In the first case, it would absorb light of all wave lengths to the same degree as a dust-cloud in our atmosphere does; but in the second, it would absorb blue light much more strongly than red, like our atmosphere itself, whose absorption in clear weather is largely due to the scattering of light by the air molecules.

Within the last few weeks very convincing evidence in favor of the existence of absorption of both these kinds has been published. Prof. Barnard, following the same line of argument developed in earlier papers, calls attention to some of the remarkable black spots in the Milky Way. One in particular, in Sagittarius, appears as an oval patch, about half the apparent diameter of the Moon, in the middle of a dense star-cloud. All around it the stars strew the sky so thickly that on the photograph their images almost overlap; but within this small region there is blackness, except for two isolated stars. A mere glance at his photographs shuts one up to two explanations. either there is a hole through the star-cloud through which we see into the abysmal night beyond, or there is an opaque body in front of the star-cloud, which hides part of it.

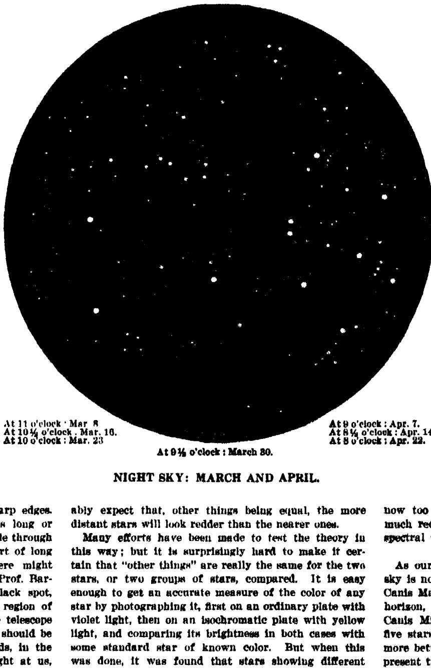
The chief difficulty about the first explanation is that the dark hole is very small compared with the cloud, and has sharp edges. If the star-cloud is about as thick as it is long or broad, which seems natural to suppose, the hole through it, to look as it does, would have to be a sort of long narrow tunnel, pointing right at us. There might perhaps be one such affair in the sky; but Prof. Barnard gives particulars of another similar black spot, equally dark, but still smaller, in the same region of the heavens, which, as he says, looks in the telescope "like a drop of ink in the sky." That there should be two such tunnel-like holes through star-clouds, in the same part of the sky, and both pointing right at us, passes belief

The alternative explanation offers no such difficulties; but the existence of huge and practically opaque regions in space, whose diameter may be a large fraction of a light-year, if not more, is so startling an idea that it needs a good deal of proving. But Prof. Barnard has greatly strengthened this idea by careful visual studies of the first of these dark regions with the great Yerkes refractor. On a clear night, with fine seeing, he finds that in this region the sky is "dull" compared with the surrounding regions, and that on one part of the area it is very faintly luminous showing that a very faint but real object occupies the place of the "dark hole" There are a number of other regions where "dark lanes" seem to be connected with visible nebulosity, but the new one is one of the most remarkable, and the evidence is now so strong as to convince most astronomers that regions of absorbing matter—"dark nebulæ"—probably exist between us and the Milky Way. The few isolated stars in the dark areas are presumably on the nearer side of the "dark nebulæ" which seem sometimes to be almost perfectly opaque.

But these absorbing regions, though almost incredibly huge, are isolated; and we can only detect them in case the great star-clouds of the Milky Way afford a luminous background on which they are projected. If the whole heavens were filled with a uniform haze of the same sort, making all the stars seem fainter than they otherwise would, we would be unable to detect it, because of its very uniformity.

The chance of detecting general absorption of this sort becomes much better, indeed, the problem only becomes soluble at all with our present means, when the absorption is of the second kind, increasing from the red to the violet. In the presence of such absorption, a star, if we could remove it to greater and greater distances, would look redder and redder, just as the sun does as it sinks in the west, so that its light has to traverse an ever-increasing thickness of air.

We cannot actually remove a star to varying distances; but, on the same assumptions, we can reasonably expect that, other things being equal, the more distant stars will look redder than the nearer ones.



NIGHT SKY: MARCH AND APRIL.

Many efforts have been made to test the theory in this way; but it is surprisingly hard to make it certain that "other things" are really the same for the two stars, or two groups of stars, compared. It is easy enough to get an accurate measure of the color of any star by photographing it, first on an ordinary plate with violet light, then on an isochromatic plate with yellow light, and comparing its brightness in both cases with some standard star of known color. But when this was done, it was found that stars showing different spectra were very different in color. So we must confine our investigations for the detection of "space absorption" to stars of exactly the same type of spectrum, and then must pick out near and remote ones for comparison of color. But we must choose stars of about the same apparent brightness, for a long exposure on a faint star may not, and often does not, give exactly the same result for the color as a short exposure on a bright star; and if two stars, one near us and one very far away, look about equally bright to us, the remoter one must of course be really very much the brighter of the two. Now it may be that a very bright star showing a given kind of spectrum tends to be redder, or for that matter, bluer, than a faint one of the same spectrum; and before we can be sure that we have evidence of the absorption of light in space, we must prove that our results have not been vitiated by some such difference in the color of bright and faint stars.

Several previous attempts have met with trouble here; but a recent paper by Dr. Adams of the Mount Wilson Observatory seems to have surmounted the difficulty.

A number of pairs of stars were selected, the two stars of each pair being alike in spectrum and similar in apparent brightness, and the spectra of each pair were photographed side by side on the same plate and developed together, taking care that the stars were at the same apparent altitude in the sky at the time of the exposures, so that the absorbing action of our atmosphere should be the same for the two. One star of the pair is chosen, if possible, from the now extensive list of stars known from direct measures of parallax to be near us; the other is selected on account of its very small proper motion in the heavens, and is therefore presumably distant. If this star is really farther away than the other (which is probable but not certain in the individual case, but sure to hold true on the average), and violet light is absorbed more than blue light in passing through space, the spectrum of the remoter star should fall off in intensity toward the violet more rapidly than that of the nearer star. Such an effect is shown in fourteen out of the twenty pairs so far photographed, and in some cases the effect is very conspicuous. There is not a single example of the contrary effect. Since all disturbing factors have been carefully eliminated, it seems clear, even from this relatively small amount of evidence, that the distant stars actually appear redder than the nearer ones.

As we have already remarked, this might be because they are of greater real brightness, not because they are farther away. But a second series of plates is now being taken at Mount Wilson, in which the stars to be compared are similar in spectrum, but of very different real brightness, while at about the same distance from us. For such stars the effects of space-absorption would be the same, but the influence of differences in actual brightness would come in to their full value.

The few photographs so far taken for this purpose seem to show that the effect of differences in actual brightness is small, if perceptible at all. If this is confirmed by fuller study the existence of absorption of violet light, to a greater extent than blue, during its passage to us from the remoter stars, will apparently be satisfactorily proved

It will not improbably be possible to estimate how great the effect is for every hundred light-years of distance; and in this case it will become practicable to estimate the distances of very remote stars, now too great even to guess at, by finding out how much redder they are than near-by stars of the same spectral type.

The Heavens.

As our map shows, the most brilliant region of the sky is now well down in the west Taurus, Orion and Canis Major lie in a horizontal line, not far above the horizon, and above them are Auriga, Gemini, and Canis Minor. This small region of the sky contains five stars brighter than the first magnitude, and nine more between the first and second magnitudes. At the present time, Mars and Saturn are both within its borders and these too appear brighter than the first magnitude, making the western sky unusually well lighted.

The southern heavens, on the contrary, are very dull. Leo, high, near the zenith, is conspicuous, but the immense constellation Hydra, lower down, contains but a single oright star, and there is practically nothing below this.

In the southeast is the small, but conspicuous group Corvus, whose two uppermost stars point straight toward the still brighter star Spica, in Virgo. Due east, at a moderate altitude, is Arcturus, with his fainter companions in Boötes. Below on the left is the semicircle of Corona Boreales, and on the northeastern horizon Hercules is rising.

The Great Bear stretches northward from the zenith to the pole. Lower down, east of north, are Draco and Ursa Minor, while Cassiopeia and Cepheus are on the northern horizon.

(Concluded on page 187.)

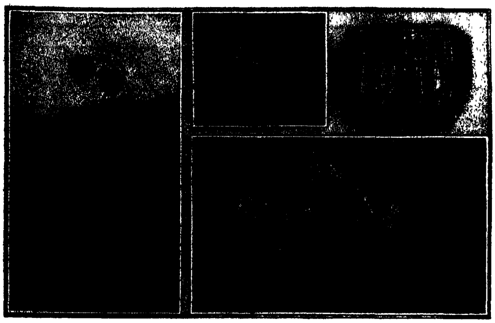
How's the Weather Up There?

By C. L. Edholm

BALLOONS sent up eighteen miles to report on weather conditions bring back the answer that it is rather chilly, 85 degrees below zero, to be accurate, which is some frost even for Medicine Hat.

As it happens, this report comes from a region nationally advertised for its mild climate, from Southern California, but the famous Pacific Coast climate is not claimed to extend indefinitely straight up.

Of course, no one was commissioned to ascend to an altitude of eighteen miles, or anything like that, merely to secure a weather report, but some very trustworthy messengers of aluminium and steel were sent up instead, delicate recording instruments inclosed in water-tight cases and carried aloft in wicker baskets by twin balloons. A series of twenty-three balloon weather soundings has just been completed at Avalon, Santa Catalina Island, off the California coast, by observers of the Weather Bureau, and the way they got results was unusual and exceedingly ingenious.



Recording weather conditions at high altitudes with sounding balloons.

The meteorograph, in its wicker basket, was suspended between two balloons of pure rubber, which were inflated with hydrogen gas and set adrift. On leaving the ground, these spheres had a diameter of 8 to 10 feet, but as they ascended, the air pressure decreased and the gas continued to expand until at an average altitude of fifteen miles the gas pressure from within became greater than any rubber could endure, and one of the twin balloons would burst. The weight of the instrument and basket was an easy load for two balloons, but it was too heavy for one alone to support aloft, so following the explosion of balloon number one, the second would slowly trail earthward, or seaward, and the meteorograph and the rubber sphere above it would float about on the waves until sighted by some passing vessel or fishing craft, or until the tides washed it ashore.

This seems as precarious as "casting bread upon the waters" in the hope of "return after many days," but as the Government allows a reward for the return of the instruments, the voyagers along the coast are alert for them. Before the entire twenty-three ascensions had been made, there were three recoveries, and it is probable that for months the announcement of further finds will be made. Those picked up during the recent tests were sent to Avalon, but the rest will be shipped as fast as received to Mount Weather, Va., to be opened and examined by the scientists stationed there.

When inflating the balloons, they were filled with enough gas to carry them as high as possible, and no variation in the amount of gas was provided that would cause the explosion of any one sphere before the other. This was left to chance, as the difference in the strength of the envelopes was sure to prevent simultaneous rupture.

The men conducting the experiments on Santa Catalina Island are all well known experts in their chosen work. Mr. B. J. Sherry has spent many years in research, and was placed in charge of the tests. His colleagues are Mr. W. R. Gregg, senior research observer at Mount Weather, and Mr. Paul Hathaway, the odolite expert, who traces the course of the balloons by means of his transit-like instrument. The photograph which shows the balloons in the air, just after leaving the Avalon golf links, as well as the detail views of the instruments, were taken by Dr. Ford A. Carpenter, weather forecaster at Los Angeles, who kept in close touch with the experiments.

When the aerial strays are safely gathered at Mount Weather, the work will be far from complete. The meteorograph records are traced by three needles upon an aluminium cylinder blackened with camphor smoke. Altitude, humidity and temperature are thus recorded, but very elaborate computation will be required on each record.

From the salt-encrusted instruments recovered and sent to Avalon, it was found that the air grew steadily cooler up to an altitude of about eight miles. There the extreme of 85 degrees below zero was recorded, but though some of the balloons went much higher, the temperature did not show more intense cold; on the contrary, it was just a trifle less chilly. This indicates a belt of even temperature of unknown thickness above that part of the earth, extending above the so-called "storm zone," which is within the eight-mile limit.

Above this zone the air currents of Southern California seem to have a steady trend from the southwest to the northeast, while below this the currents are variable; generally from the west

It is hoped that permanent stations in the West and Northwest may be established for balloon soundings at great altitudes, as a prolonged observation of the results would undoubtedly throw light on many a problem that has puzzled the weather man, and enable the forecasters to predict with far greater accuracy the approach of storms and the other phenomena that are of such direct and practical importance to the average man.

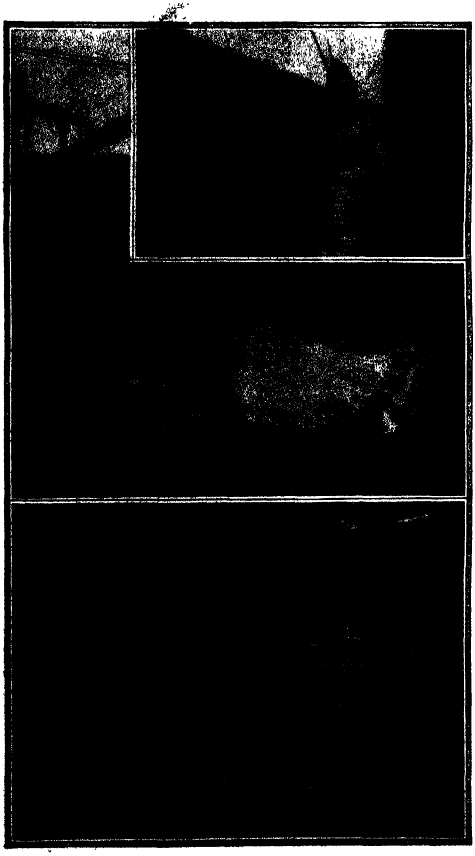
A Novel Hull-cleaning Apparatus

AN Australian inventor has concentrated his energies upon the perfection of an apparatus and method which, while effectively cleaning a vessel's hull, at the same time enables the operation to be achieved quickly, cheaply, and without the necessity for dry-docking. He realized that the cleaning of the hull could be carried out while the vessel was discharging and reloading and not at all delaying her

The cleaner comprises a flat-bottomed barge thirty feet in length by twelve foot beam, which draws from two and one half to three feet of water. It is fitted with a special winch, submersible brushing gear, and the necessary electric generating plant. A crab winch fore and aft suffices for manipulating the mooring ropes There is also a propelling motor for driving the barge, which is thus able to move under its own power at about five knots an hour

The cleaning gear consists of a brass and gun metal frame in which is mounted the brush, electric motors, and the propeller, the last constituting an outstanding feature of the invention The brush is longitudinally mounted upon the front side of the frame. It is five feet in length by twelve inches in diameter, and is fitted with two and one half inch fiber bristles Behind the brush is a three-bladed phosphor-bronze propeller Between the brush and its propeller an electric motor is fixed for driving both the brush and its propeller. The motor is of a special submersible type and receives current through a three-core rubber-sheathed cable The brush is driven by chain gearing from an intermediate shaft, which itself is driven through worm gearing by the motor. The latter also drives the propeller.

In operation the barge takes up a position alongside the vessel to be cleaned, and is made fast fore and aft. The brushing gear is lifted overboard by means of the winch and derrick, and is lowered into the water The brushing motor then is started. The action of the brush propeller, combined with the manner in which the gear is slung overboard, forces the frame gearing and revolving brush hard against the vessel's hull, and the propeller keeps it well up to its work While running, the gear is gradually lowered in a vertical direction, still pressing against the hull, to such a depth as the steamship's draft may require The gear is then raised to the surface, the brush still rotating, the barge is moved forward a distance of four feet, and the operation repeated. It will thus be seen that the hull is cleaned in vertical strips, and although the latter are five feet wide—the length of the brush—by moving the barge forward only four feet at a time, an ample margin is provided to insure complete overlapping of adjacent cleaned strips



A machine that scrubs barnacles from ships' bottoms.

The Motor-driven Commercial Vehicle

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The Editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles.

The Motor Truck in Snowbound Streets

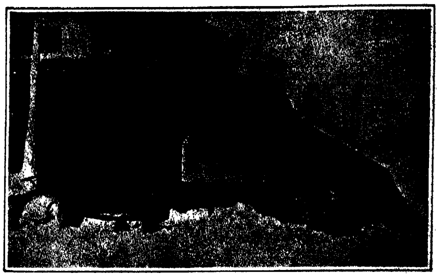
THE seventh annual automobile number of the SCIENTIFIC AMERICAN, published in January, 1905, had on its cover the picture of an automobile in a snowstorm. This was so unusual a scene as to create a sensation. Up to that time the motor car had been looked upon as a pleasant weather vehicle, to be stored in the garage at the first fall of snow. Little did we think then that within a few years it would be our mainstay in winter storms, not merely for passenger service, but for the transport of merchandise; that when the ordinary wagon could barely be kept moving with the aid of two and four extra horses, large motor trucks bearing many times the load of coal or milk or other indispensable commodities would pursue their powerful course despite the obstructing snow.

We in New York had almost forgotten that the motor truck was so efficient until we were suddenly overwhelmed the other day by a heavy snowstorm—the first of any consequence in over a year. At the first opportunity we sent our photographer out to record some of the difficulties of vehicular traffic, and to show how motor trucks were getting on under such adverse conditions. The manner in which motor vehicles plowed along despite the heavy handicap was very gratifying To be sure, there were many sections which even they could not traverse, but by comparison with the work of the horse that of the motor was remarkable.

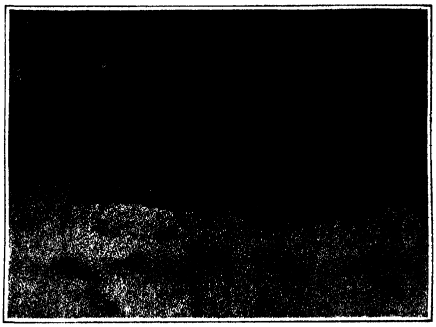
The poor horse is not provided with a reduction gear which will enable him to use his powers to better advantage. Unfortunately, he is a direct connected motor and there is no way of easing up the work without the use of tackle, which obviously is impracticable in congested streets.

Although a motor may be powerful enough to turn the driving wheels, under any conditions, this does not necessarily mean progress, for the wheels may slip, and therein lies a weak spot in driving motor vehicles through snow. Without tire chains or their equivalent progress is almost impossible. In some situations even tire chains do not furnish sufficient grip.

Another weakness is to be found in the differential which permits one wheel to remain stationary while all the power of the engine is expended in idly spinning the other. Formerly electric vehicles used two motors, one for each driving wheel; but the advantages of a single motor have led to its almost universal adoption despite the necessity of employing a differential gear; and so now the majority of electric trucks are in the same class with the gasoline truck as regards this particular weakness



Faithfully at work in a blizzard "tie-up."



Breaking a path through deep snow.

Motor delivery wagons proved invaluable to the department store.

The photographs shown on the accompanying page were, with one exception, taken on the streets of New York and Brooklyn. The one exception is that of a five-ton coal truck which did remarkable work in Cleveland, Ohio, during the blizzard of last November. It happened that this truck had been promised to a coal company in Cleveland for a demonstration during the worst days of the storm, and although vehicular traffic throughout the city was practically at a standstill, this truck started out Monday morning with an inexperienced driver and worked steadily without stop until 8 A. M. Tuesday. Two hours later the truck started out again and worked until 3 A. M. Wednesday, and then beginning again at 7 A. M. Wednesday it worked until the afternoon, when it started hauling groceries. During all the working hours the engine was kept running continuously and little time was spent in loading and unloading. While the truck was in service the coal company tried to use its teams as well, but found it impossible to get around with four and six horses to a wagon. Altogether during the three days of the storm it ran about five thousand miles and used up over sixty feet of tire chain, the action of the snow causing the links to twist and break off. A better record for a motor vehicle could hardly be desired.

Steel vs. Wood for Motor Truck Wheels

By Elmer J. Lamb

A RIGID and exacting series of tests has just been completed in the school of mechanical engineering at Purdue University to show the relative efficiency of steel and wood as material for motor truck spokes. In the investigation wooden wheels constructed according to the specifications of the Society of Automobile Engineers and steel wheels of standard dimensions, but of steel stampings, were used. The tests were conducted under the direct supervision of Professors L. V. Ludy and H. H. Schofield. They included not only tests to which a wheel would be subjected under actual road conditions, but also such as would show the ultimate strength in every detail. The wheels were subjected to four tests, and in each the steel wheel built for a load of only a ton and a half proved superior to the wooden wheel built according to 2-ton truck specifications. The steel wheel was built entirely of steel with the exception of the rim, which was built of wood, so that it might be available for any kind of a tire. The rim and the hub were connected by a pressed steel web fastened together with rivets.

The tests brought out clearly the present difficulty experienced by most manufacturers in obtaining a grade of lumber sufficiently uniform for the manufacture of automobile wheels. The present scarcity of good material makes it possible that

Pursuing its powerful course despite the storm.

The snow did not stop the delivery of pianos.

[illegible] In the case of the wooden wheels failure was always apparent in one place, thus showing slightly defective material, although as a whole they fulfilled the specifications. The steel wheels when tested beyond their capacity gave away more uniformly.

The first experiment corresponded to the twisting force or torsion of the hub on a wheel mounted upon the driving axle of a truck traveling under a load. The load was applied to the rim of the wheel and the rim held stationary, while a force was applied to the hub so as to twist it. The force was applied in the manner that the drive of the motor would be applied under actual road conditions.

The second test consisted of holding the wheel stationary on the axle and applying a load to the rim on one side, corresponding to the force exerted on the wheel of a truck, skidding and striking a curb or other obstruction.

In the third test a wheel was placed in a vertical position on its rim in a static testing machine and the load applied directly across the diameter, the load being increased to determine the strength of the wheel. Finally, the wheel was supported by the rim on two sides, lying horizontal, and the load was applied to the hub. According to the university authorities there is no record at the present time of any wheel's being submitted to this test in the past.

Minnesota Road Patrol System

MINNESOTA'S designation of 11,000 miles of arterial roads as the State road system has already done much to advance the land values and place the "North Star State" among the first rank as regards road improvement. In 1914 Minnesota will spend $2,500,000 for roads and bridges, and will inaugurate a system of road patrols for the maintenance of the State roads. Nearly 1,500 patrolmen will be assigned to five and eight-mile sections of the State highways, and will be held responsible at all times for the condition of the roads. The plan was originated and adopted at the request of State Highway Engineer G. W. Cooley. Twenty per cent of the one mill State road tax and a similar amount of the county appropriations for road work must be used for maintenance under the law passed a year ago. This makes available $500,000 for the new patrol system.

Motor Truck Notes and Queries

D. L. C. writes: "The 30 horse-power motor of my two-ton truck seems to lose power on a hill and to pound and knock, even though the spark is well retarded. Another business man in town who operates the same kind of a truck tells me that there is probably an accumulation of carbon in the cylinders, and that this should be removed if I would obtain satisfactory results from the motor. It is quite probable that this should be done, but I cannot spare the truck for the several weeks that would be required to overhaul the engine. Is there any short-cut by which I can overcome this difficulty, and how may I best avoid such trouble in the future?"

A. From the symptoms that you have given, it seems probable that your friend's diagnosis is correct, but it is hardly necessary to dismount the motor entirely for the removal of the offending carbon. By a new process, it is only necessary to remove the valve caps and introduce a certain form of blowpipe into the combustion chamber. This blowpipe is connected with an oxygen tank, and when united with the carbon in the cylinder, forms an ignitable mixture that will burn the cylinder and piston heads absolutely clean of the carbon deposit. The flame is automatically extinguished as soon as the carbon has been burned, and therefore the heat [illegible] the interior of [illegible]. It is advisable, however, that the piston should be at the top of its compression stroke in the cylinder before the mixture is ignited, for the heat would be liable to scorch the smooth surface of the cylinder walls over which the piston passes. The operation requires but an hour or so for the removal of carbon from all four cylinders, and the engine is cleaned more thoroughly than would be the case were the surfaces scraped. One of the most satisfactory methods of avoiding the accumulation of carbon in the cylinders is to pour a couple of ounces of alcohol through each priming cup or spark plug opening when the motor has finished its work for the day, but is still hot. This will serve to loosen what carbon may be collected, and it will be blown out with the exhaust when the motor is started the next morning. It is advisable to do this about once a week, although the use of the correct amount and proper quality of lubricating oil is an important consideration.

P. N. E. writes: "A few years ago several motor trucks of leading makes were designed with a differential lock. What was the purpose of this, and is it considered an advantage?"

A. The differential lock was designed to give the effect of a solid rear axle so that each wheel would revolve at the same speed, regardless of tractive conditions. It was designed especially for trucks that were to be used over country roads where there was a liability that one wheel would strike a soft and slippery place. In this case, the differential would transmit the motion intended for the one wheel to the other that was free to revolve, and this would spin at high speed without moving the truck. A means of locking the differential caused the power to be transmitted equally to each rear wheel, and therefore the one that rested on the good tractive surface would move the truck out of the mudhole. Of course the use of chains, ropes, or other similar devices would prevent this slipping and would serve the same purpose as locking the differential. It is claimed by some engineers that the differential on a motor car is a prolific source of skidding, but its use is necessary if it is desired to save tire wear.

L. K. J. asks: "What is the attitude on the part of the leading truck manufacturers toward free service and maintenance guarantees?"

A. Many motor truck manufacturers are awakening to the injustice that is being done themselves, as well as the industry as a whole, through the abuse of service guarantees. The manufacturers cannot be expected to be held responsible for poor service obtained from a truck because of flagrant abuse on the part of the owner or driver. The most satisfactory system seems to be that in which the truck dealer undertakes to store and care for his client's car for a stipulated sum per month, and to guarantee service during certain hours of every working day of the year. For this guarantee, the dealer charges a sum sufficient to show a reasonable profit on the storage, gasoline, oil, and necessary overhauling, while repairs that are caused by defective parts are cared for by the factory guarantee. Such a service is maintained in many of the large cities where certain trucks are sold, and this system has proved advantageous to dealer as well as truck owner. If the service contract includes keeping the truck in repair, the dealer generally stipulates that he shall furnish the driver, and that the owner himself shall not be allowed to make any adjustments. Furthermore, the truck must be stored in the dealer's garage so that it will be constantly under his care and he may know that it is operated properly. Knowing the truck as he does, the dealer is then able to assume responsibility for its regular over-capacity whenever the first vehicle is out of commission. Such a system naturally saves bickering and hard feeling between truck manufacturer or agent and owner, and this is a healthy sign pointing toward the elimination of the much-abused free truck service.

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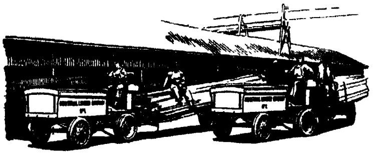

THE tractors shown have a 2-ton rating, a speed of 10 or more miles per hour, and a normal mileage of 35 per charge. We are building a 3½-ton tractor for the N. Y. Street Cleaning Department. (Repeat order)

THESE new G. V. Tractors cannot perform miracles, but where they can be used to advantage the saving is wonderful. If you have a towing problem, write at once for Bulletin No. 101. You'll find it interesting, anyway

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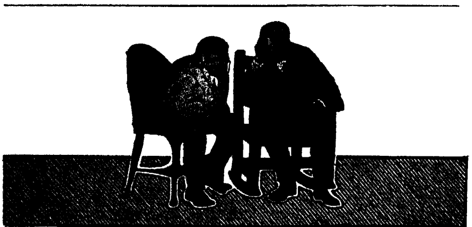

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O.K. Chas. P. Steinmetz

From an Approved Report of Some Extemporaneous Remarks of Dr. Chas. P. Steinmetz at a Recent Meeting of Engineers.

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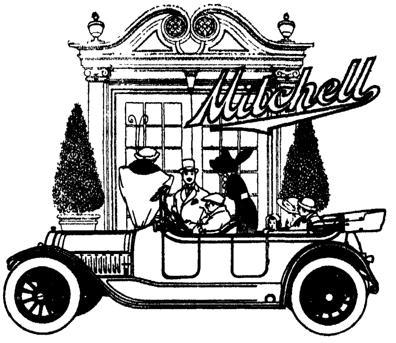

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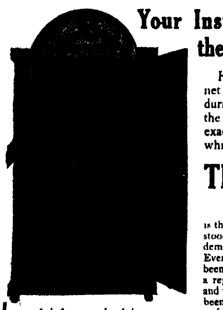

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A Triumphant Struggle With a Beetle

(Concluded from page 180.)

proportion of infections was very small. If 100 sound larvæ were imprisoned in a salmon case with say 20 infected ones and fed on rotting materials, no more than six or eight of the sound larvæ would, during these early days of experiment, be attacked by the fungus. From his own experiences with these beetles, and with this fungus, Dr. Doane did not see much relief in that direction, and so reported. However, Dr. Friederichs continued his patient labors and eventually he bred new habits into the fungus, created a new appetite for the living larvæ of the beetle, and at last produced such a virulent fungus, that when five or six infected beetles are confined with one hundred sound ones, 98 per cent or more will soon find themselves in trouble.

It has now become the custom in German Samoa to carry infected rubbish and beetle larvæ to the outdoor "Tumus," and deposit it in them, and as one of these is placed on every acre of cocoanut lands, and as the mother beetles are very fond of these artificial nests, nearly all of the eggs deposited come to nothing at all.

The strength and efficiency of this fungus has now so greatly increased that many of the mother beetles coming to oviposit are themselves attacked and they fly away with enough of the infection to poison the galleries in the cocoanut trees and spread the contagion among their neighbors.

The Samoans who under the law gather beetles and larvæ every Monday morning are now bringing in quantities of fungus-fed beetles, and the plague is very much abating.

Here in the islands we regard this achievement as a remarkable one; and as this means of combating the greatest enemy the cocoanut tree has, ought to be known in all tropical countries, we send it to the SCIENTIFIC AMERICAN, which circulates everywhere, and whose word is taken as emphatic and dependable.

Prolonging the Naval Stores Industry

(Concluded from page 173)

trees or in cutting the boxes preparatory for the next season's flow. As a result of this work a certain amount of crude turpentine is collected during the winter, but it is almost entirely from ducts already in the wood and not from secondary ones. The flow of this resin does not continue very long, for the wound becomes clogged, presumably from oxidation and crystallization of the resin, and the flow ceases

The secondary resin ducts formed above the wound are filled with resin which has no opportunity to escape until a thin chip is cut off. When this is done the flow is much more vigorous than from the original wound. In about a week, however, clogging up occurs again and another chip must be removed As this wound extends slowly up the tree new or secondary ducts keep pace with it If too large a chip is cut the productive secondary ducts are cut off and the run materially lessened.

Failure to understand the physiology of resin formation and to adjust the methods of turpentine orcharding to it has resulted in untold losses and a very serious depletion of a valuable resource. It is also responsible for one of the chief criticisms against the cup and gutter system. It is a common experience that, although the total yield from the first year of the operation is greater than under the box system, nevertheless an unusually large number of weekly chippings has been found necessary to secure the first dipping from cups—six to seven chippings as compared to four under the box system.

In the light of the above explanation of the formation of secondary resin ducts this shortcoming is readily explained and avoided. Under the box system the boxes are cut during the winter and the trees are "cornered," that is with the upper edge of the face ready for chipping. The new ducts form, the first chip opens them up the full length of the cut and a good run is at once secured. In placing cups, however, the common practice has been

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Inquiry No. 9360. Wanted the name and address of parties making pipe fittings such as ferrules, stems and bowls such as could be used in the making up of calabash pipes for smoking.

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This Washer eliminates *labor* and practically saves all *cost*. Does a big family washing *for 2 cents a week*—yes, and the *wringing*, too! It's one of the greatest marvels the world has ever known. Runs by electricity or water power. Washes a tubful *spotlessly clean* in two to six minutes! Wrings out the clothes to perfection as fast as you feed them—prove it at our expense.

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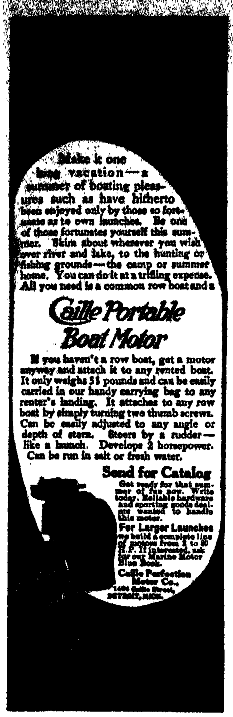
Make it one long vacation—a summer of boating pleasures such as have hitherto been enjoyed only by those so fortunate as to own launches. Be one of those fortunates yourself this summer. Skim about wherever you wish over river and lake, to the hunting or fishing grounds—the camp or summer home. You can do it at a trifling expense. All you need is a common row boat and a

Caille Portable Boat Motor

If you haven't a row boat, get a motor anyway and attach it to any rented boat. It only weighs 55 pounds and can be easily carried in our handy carrying bag to any renter's landing. It attaches to any row boat by simply turning two thumb screws. Can be easily adjusted to any angle or depth of stern. Steers by a rudder—like a launch. Develops 2 horsepower. Can be run in salt or fresh water.

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Get ready for that summer of fun now. Write today. Reliable hardware and sporting goods dealers wanted to handle this motor.

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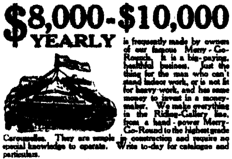
$8,000-$10,000 YEARLY is frequently made by owners of our famous Merry-Go-Rounds. It is a big-paying, healthful business. Just the thing for the man who can't stand indoor work, or is not fit for heavy work, and has some money to invest in a money-maker. We make everything in the Riding-Gallery line, from a hand-power Merry-Go-Round to the highest grade Carousselles. They are simple in construction and require no special knowledge to operate. Write to-day for catalogue and particulars.

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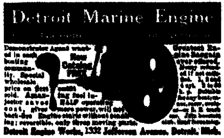
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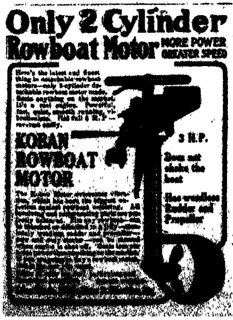
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KOBAN ROWBOAT MOTOR

3 H.P.

Does not shake the boat

Has weedless Rudder and Propeller

[illegible]

to make with the broad ax two flat faces, meeting at the center, on which the cuts for insertion of the gutters are made. The upper portions of these faces have oval outlines instead of straight as in the preceding case. The resin ducts formed follow the curved upper edges of the faces. The first chipping is made from each side to the center, and the result is that instead of the new ducts being opened up along the entire cut, only those near the middle of the face are cut. Naturally the flow at first is considerably less than where the trees are "cornered."

The solution of the difficulty presents itself immediately the cause is understood. During the winter months, when the gutters are placed upon the trees, the chipper should make a regular chipping the full width of the face. Secondary resin ducts will form along the entire length of this cut and the first application of the hack in the spring will start them all to flowing at once. Actual tests have demonstrated the correctness of the theory and resulted in a gain of one extra dipping or about thirty barrels of crude turpentine per crop of 10,000 cups. The saving to the entire industry is enormous.

French turpentine is considered superior to American. It is obtained from maritime pine (*Pinus maritima*), which produces a resin yielding 25 per cent turpentine as compared to 17 per cent for long leaf pine. The tree has the ability to grow rapidly on poor sandy soils. The United States Forest Service is now experimenting with it in Florida, and the prospects are so far very promising. Maritime pine grows more rapidly than loblolly and produces more resin than long leaf. It attains size large enough to cup in thirty years as compared to one hundred years for long leaf. There are large areas of cheap land in the South which are well adapted to its growth in case the experimental plantations fulfill their present promise of success.

The Heavens in March

(Concluded from page 182.)

The Planets.

Mercury is evening star until the 10th, when he passes through inferior conjunction and becomes a morning star; but he can only be well seen at the very end of the month, when he rises an hour before the Sun.

Venus is evening star, and is coming into sight again, so that by the end of March she sets an hour later than the Sun, and is easily seen.

Mars is in Gemini, long past opposition, but still about as bright as Procyon. During the month he moves eastward about 10 degrees, and his motion can easily be followed with the naked eye, even from night to night, especially on about the 8th, when he passes about 1 degree north of the third magnitude star ε Geminorum.

Jupiter is a morning star in Capricornus, rising about 4:30 A. M. in the middle of the month. Saturn is in quadrature with the Sun on the 2nd, and after this counts as an evening star, though he remains visible till about 1:20 A. M. at the beginning of the month, and 11:30 P. M. at its close.

Uranus is a morning star in Capricornus. At 4 A. M. on the morning of the 4th he is in conjunction with Jupiter, being south of the brighter planet, at a distance of only nine minutes of arc. The two planets will be separable only with the aid of a field-glass, and Uranus will appear about as near Jupiter as his own satellites, but in quite a different direction. Unfortunately, this interesting conjunction can only be observed under rather unfavorable conditions, at about 5 A. M.

Neptune is in Gemini, and crosses the meridian a little after 8 P. M. in the middle of the month.

The Moon.

First quarter occurs at midnight on the 4th, full Moon at 11 P. M. on the 11th, last quarter at 8 P. M. on the 18th, and new Moon at 1 P. M. on the 26th. The Moon is nearest us on the 12th, and remotest on the 27th. She is in conjunction with Saturn on the 4th, Mars on the 6th (pretty closely), Neptune on the 6th, Uranus on

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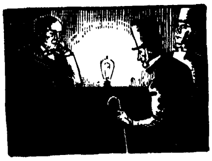

How Far Back Does Your Memory Go?

Have you ever given your memory a real test?

Take some object that you are accustomed to seeing every day—the electric light for instance.

When did you *first* see an incandescent electric lamp?

Stop and think a minute! It's almost impossible to recall your first experience with such familiar things, isn't it?

And just think, away back in 1879, when Edison exhibited his *first* incandescent lamp—Richmond Straight Cut was already considered the "Henry Clay" of cigarettes. In the changing years that have followed, it has never lost its place. It is still the best of all Virginia cigarettes.

True, our memories may be fickle with the crowding, commonplace incidents of busy days, but which of us does not remember quality?

20 for 15c Liggett & Myers Tobacco Co.

Friends for forty-two years

the 21st, Jupiter on the 22nd, Mercury on the 24th, and Venus on the 27th.

At 6:03 A M. on the 21st, the Sun crosses the celestial equator and "Spring begins," technically speaking; and on the night of the 11th there is a large partial eclipse of the Moon, which is well observable throughout the United States.

The Moon first reaches the penumbra of the Earth's shadow at 8:41 P. M. by Eastern standard time. The umbra, or dark shadow, is not reached till 9:42. From this time on the eclipsed area increases until, at 11 18 P. M., eleven twelfths of the Moon's diameter is immersed in the shadow. Then the eclipse diminishes, and the last contact with the shadow occurs at 12:44 A. M., though the Moon does not clear the penumbra till 1:45.

This eclipse is so nearly total, and occurs at such a convenient hour of the evening, that it should be watched by great numbers of amateur observers.

Further observations of Delavan's comet, of which we spoke last month, and the orbit calculated from them by Van Biesbroeck, show that its perihelion distance is actually about ten per cent greater than that of the Earth, the inclination of the orbit about 68 degrees, the motion direct, and the perihelion passage not until October 26th, 1914. The comet is still very unusually remote from both Earth and Sun, its distance from the latter being more than four astronomical units at the time of discovery. It must be a very big comet to be visible at all at this great distance. When near perihelion next October it will be high in the northern sky, probably visible to the naked eye, and perhaps fairly conspicuous, though its perihelion distance is rather large for the formation of an extensive tail At present it is of the magnitude 10.8, and its position is as follows:

	R A	Declination.
March 1 . . .	2h. 42m. 22s.	3° 40′ N.
March 13	2h. 47m. 21s	5° 54′ N
March 25 . . .	2h. 54m. 12s.	8° 9′ N.

It is getting rather near the Sun, and is observable only in the early evening.

Princeton University Observatory.

The New Wright Aeroplane Control

A NEW form of aeroplane control has been devised by Orville Wright, and is thus described by him:

"The usual lever system has been replaced by an automobile type of steering wheel in combination with a handle, which makes the control not only stronger and simpler, but makes it much more effective. Formerly the elevator was controlled by a forward and backward movement of a lever in the left hand, while the warping and rudder were controlled by the forward and backward movement of a lever in the right hand, the rudder being offset for a turn by turning the handle of this right hand lever. This control, which has been used ever since 1908, was very effective for exhibition flying, for which it was particularly designed, and has proved a very precise one when once mastered. But for long distance flights many aviators found this control tiresome, and in the new and safer machine it is necessary to modify it into the new form.

"The steering wheel is of automobile type and the control is perfectly instinctive, the wheel being pushed forward and backward to control the elevation of the machine and turned from side to side to balance it laterally. In turning the wheel from side to side the rudder handle is turned with the wheel, thus giving a perfect lateral balance, and in turns it is only necessary to offset the rudder handle to one side or the other, still controlling the lateral position of the machine by turning wheel and handle together sideways.

"This type of control was adopted after very careful study had been made of all existing systems, and combines many features that have become standard in Europe. The control for lateral balance by the steering wheel is a standard requirement in the German army and is used on the German Wright aeroplanes

"The novel feature of the control is the simple manner in which the rudder control is combined with the warping."

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a year in sales was the result of using a certain selling method by one American house. Many others have done better Read all about this method itself in the new book, "The Premium System of Forcing Sales: Its Principles, Laws and Uses," by Henry S. Bunting, who spent six years in investigating this subject. The book will be sent you absolutely free with a year's subscription (two dollars) to The Novelty News, the magazine for the advancement of selling methods, 190 S. Market Street, Chicago.

SCIENTIFIC AMERICAN

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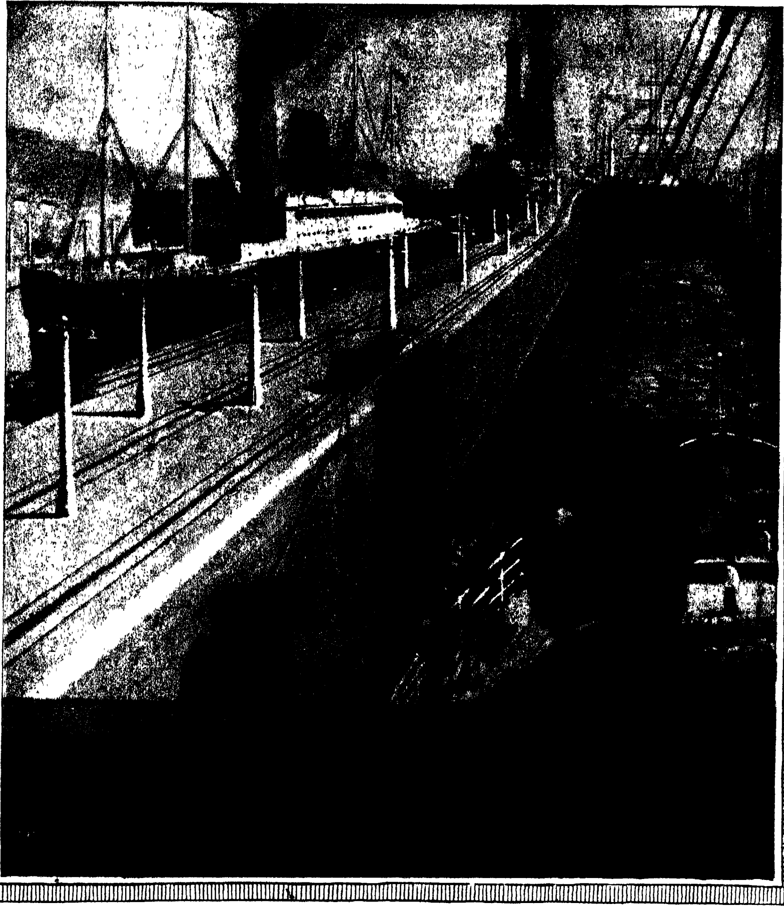

Problem of the Navy—II. Sea Power and Our Foreign Policies

The Navigating Lights of the Canal

How the Lock Gates of Panama will be worked

Vol. CX. No. 10
March 7, 1914

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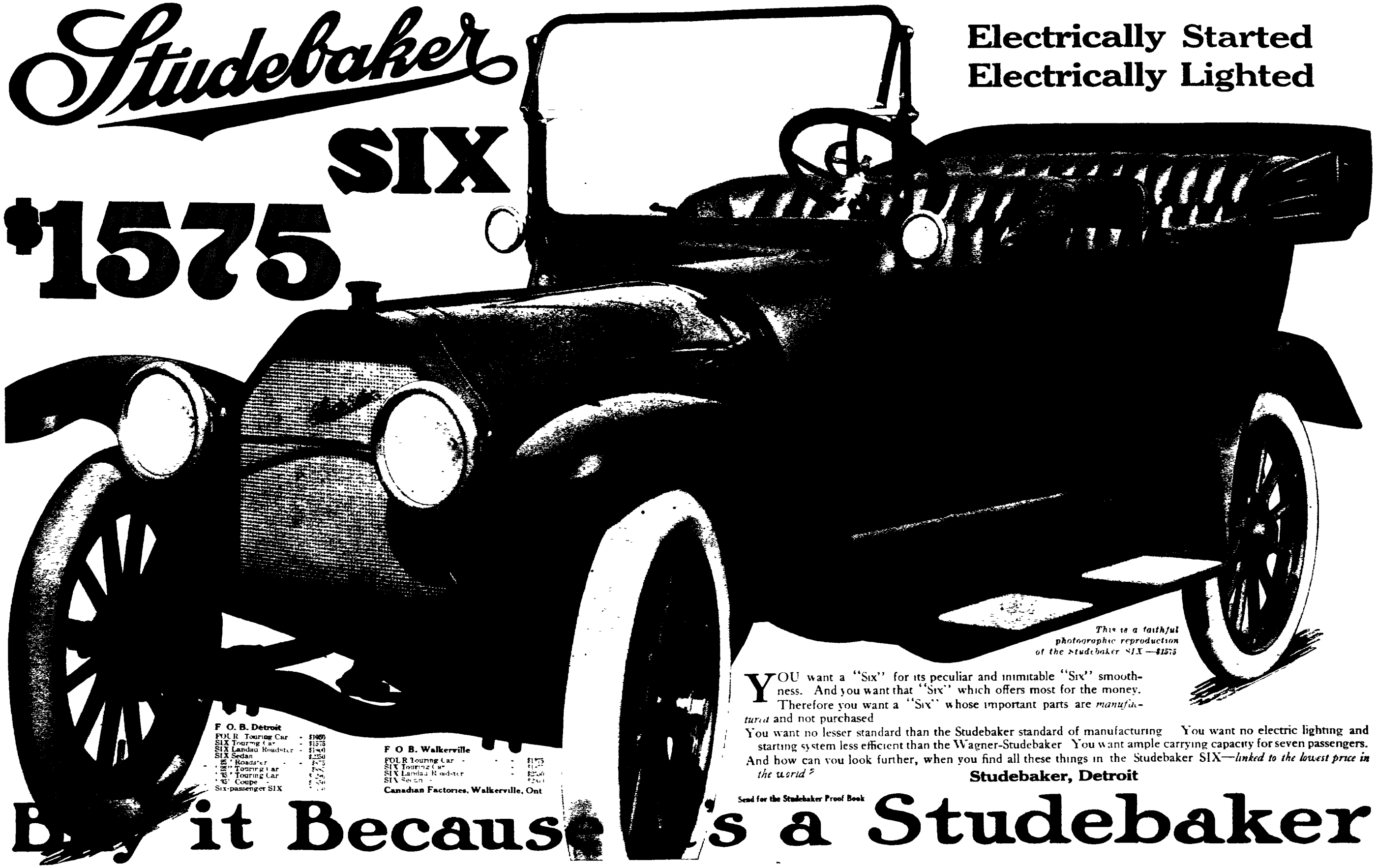

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You want no lesser standard than the Studebaker standard of manufacturing. You want no electric lighting and starting system less efficient than the Wagner-Studebaker. You want ample carrying capacity for seven passengers. And how can you look further, when you find all these things in the Studebaker SIX—*linked to the lowest price in the world?*

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A Million Dollars In a Week

A thousand cars in seven days—a million dollars' worth of Jeffery Fours and Sixes sold in a week—that is the record established by the Jeffery organization at the Chicago show.

One hundred and thirty-eight cars were sold for immediate delivery. Dealers' orders were taken for one thousand and seventeen for delivery before April first.

Seven thousand dealers' orders have been taken to date. This number exceeds the possible production of the big Jeffery works for five months to come. It means that in March, April, May and June, Jeffery cars will be hard to get.

The public now knows that the Jeffery Four leads the medium priced field. It is now simply a question of factory production and deliveries.

Fifteen hundred and thirty-nine people registered for demonstrations during the Chicago Show. Manufacturers of other cars, salesmen interested in other lines and dealers selling all cars came to see the Jeffery—all conceded the Jeffery Four at $1550 to be without competition.

A buyer stepped into the exhibit of a five thousand dollar car near us. He said, "What do you think of this Jeffery over here?" The salesman replied, "I think so well of it that I told a friend of mine—who cannot pay our price—to go and buy a Jeffery."

Thirty cars a day are being produced in the Jeffery works. Think what it means to build that number of cars in the Jeffery way.

Fifty-six Jeffery Fours and Sixes were shipped by the factory on a day when a blizzard was raging through the country. The Jeffery pay roll today is the largest in the history of the company. The shipments for January exceeded by one hundred per cent those of January one year ago. February beat the same month last year by two hundred per cent.

A great period of prosperity is opening up in this country and the big Jeffery organization, with the new Jeffery Four and Six, is on the wave.

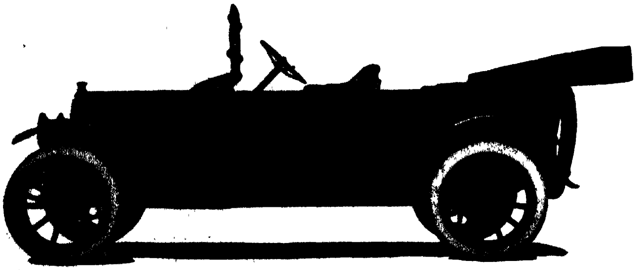
There are reasons for this prosperity. Here they are:

The Jeffery Four is the first light weight, high grade car, equipped with a modern European type of high speed bloc-type motor, to sell in this country for less than $2500.

Take it from the tip of the radiator to the tail lamp and there is quality in every detail. Bosch Duplex system, Rayfield carburetor, electric starting and lighting system, four speed transmission, imported annular ball bearings, Spicer universals, full floating type rear axle with imported annular ball bearings, Rothschild body, and quick getaway—from nothing to forty miles in twenty seconds.

In 1916 the Jeffery type of car will be more common. The great demand for light weight and economy is forcing other manufacturers to imitate us. The day of the big, bulky car is gone and the Jeffery car is the car of the hour because—

It's Economy Year, and Jeffery Made It So



Jeffery Four

Two passenger Four	$1550
Five passenger Four	1550
Four passenger Sedan Four	2350
Limousine Four	3000
Two passenger All-Weather Car	1950

Jeffery Six

Two passenger Six	$2250
Five passenger Six	2250
Six passenger Six	2300
Five passenger Sedan Six	3250
Limousine Six	3700

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Is Vibrationless, quiet and smooth running.

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Is powerful enough to tow several other boats.

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In designing our 1914 models we have made them the most modern achievements in gasoline motor construction. To add to their well known, great efficiency we have installed another exclusive Evinrude feature, the

Built-In Reversible Magneto

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The motor drives the average rowboat 8 miles an hour or may be slowed down for trolling. Speed with a canoe 12 miles an hour. The "Evinrude" has been adopted by twelve governments and is used universally.

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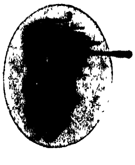

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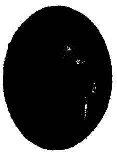
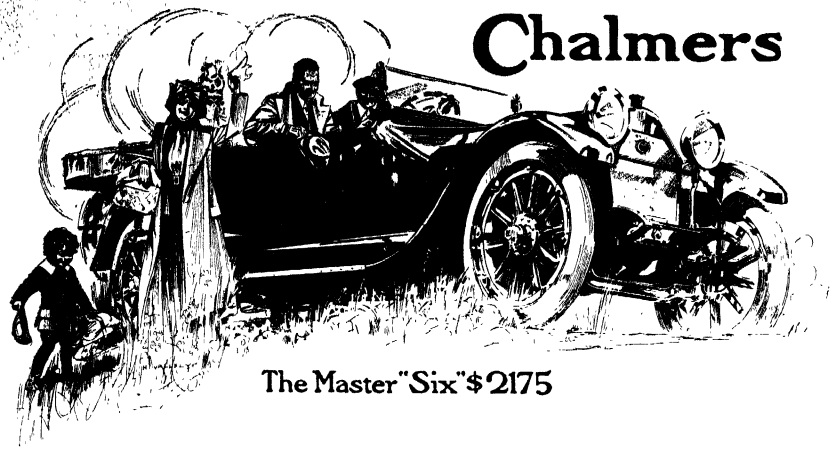


Chalmers



The Master "Six" $2175

Motor Folks call me the Master Six.

I have earned the title. I have set a new record for sixes. In one month alone men paid over $2,000,000 for me. They had all the sixes of the world to choose from. They chose me.

But first they made me prove myself. They put me to tests equal to a season's service. Only by living up to every claim did I win them.

Because I told my story in deeds rather than words—they were convinced, for they couldn't deny what their eyes saw—what their senses perceived.

Let me tell you in deeds the story of my master motor. It will win you as it won them.

The Turning of the Tide

Swiftly and surely the tide has turned to the Sixes. Motorists no longer are content with a power that lets go and grabs again at every other revolution. They now insist upon that quiet, steady pull, that luxurious smoothness that can come only from six cylinders.

Until the Master Six appeared last year, buyers had thought of all Sixes as heavy cars, extravagant of fuel and tires; costly to buy and expensive to keep. But the Master Six opened their eyes.

Here was a car of six cylinders at a moderate price, and even lighter than many 'fours' of equal power. Here was a motor so silent and smooth running that friction and wear might be forgotten. A car which costs little to buy and little to keep.

Power Lithe as a Panther

Its master motor has six cylinders of long stroke and small bore. So it fairly floats up the hills on high gear. It can reach twenty-five miles an hour in ten seconds from a standstill. It can creep like a snail through the crowd and then be off like a greyhound at the touch of the throttle.

This ability to run fast or slow on direct drive, to vary the speed at will without constantly shifting gears, puts the Master Six head and shoulders above its rivals. It gives a flexibility of power that is possible only among Sixes—and rare even there.

Vibration is Power Thrown Away

Vibration is wasteful as well as uncomfortable. It is power and fuel thrown away in joggling the car which should be used in propelling it. It throws useless strain upon bearings and tires It means discomfort for the passengers, and increased fuel bills It means the very life of the car cut short.

And vibration can't be cured by a makeshift. The only escape from it is in a six cylinder motor, where the impulses overlap; where the flow of the power stream is continuous.

The easy gliding motion of the Chalmers Six is like a caress. You who have never driven a real Six know nothing of its charm.

A One Motion Starter—A Non-Stallable Motor

One swing of a switch at the outset—and this is what happens. The Chalmers-Entz electric starter spins the engine to start it.

But that isn't all. If some unusual demand upon the engine should cause it to falter, the starter keeps it running until it picks up again.

There's no chance to be stranded in a throng or on a dangerous crossing. It makes the motor unstallable. In simplicity and sureness, the Chalmers-Entz system is without a parallel

The Test That Tells the Tale

The true measure of value and the only one—is performance. What will the car do in service?—that's the question.

So we have arranged the Chalmers Road Test We make our appeal for the Chalmers Sixes through the cars themselves We submit the evidence of deeds rather than of words.

Make this test it is more than just a ride Put the burden of proof on the car itself. It can't conceal; it can't exaggerate It will give you a new standard by which to judge other cars

The Master "Light Six" $1800

I am the Chalmers Light Six.

The son of a king—the Master Six.

I am like my illustrious sire though built in a lighter mould. I have speed—more than you'll need. Though my master motor is light I have power to spare. Light on my feet, I am saving on tires and frugal with fuel. I am easy to buy and easy to keep.

Six-Cylinder Value--Four-Cylinder Price

Many have waited for this day to come They want a car of low first cost, yet a car of generous size and ample power A light car, but not a little one But this car must be a Six For they know that means a car easy to ride in, easy to run, and easy to keep In the Master Light Six everything has been reduced to the simplest form yet nothing essential has been omitted It gives the luxury and economy of the Six at the price of a "Four"

Safety First Always

When you ride in the light Six you can trust it Frame and axles are of heat treated steel with a four fold margin of safety Gears and roller bearings have withstood a crushing test of fifty tons Its brakes will stop it within its length Its electric starter prevents the motor from going dead at a critical moment The gears lock themselves in mesh The shifting device won't let you go wrong The assurance of safety is the corner stone of motor pleasure

Look at these features and try to match them at the price

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- Molded Oval Fenders
- Non Stallable Motor
- Electric Lights
- Triple Heated Fuel
- Timken Roller Bearings
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- Chalmers Sectional Piston Rings
- Multiple Disc Clutch
- Underslung Springs
- 48 Horsepower
- 126 Inch Wheel Base
- Electric Starter
- Clean Running Board
- Tungsten Steel Valves
- Left-hand Drive
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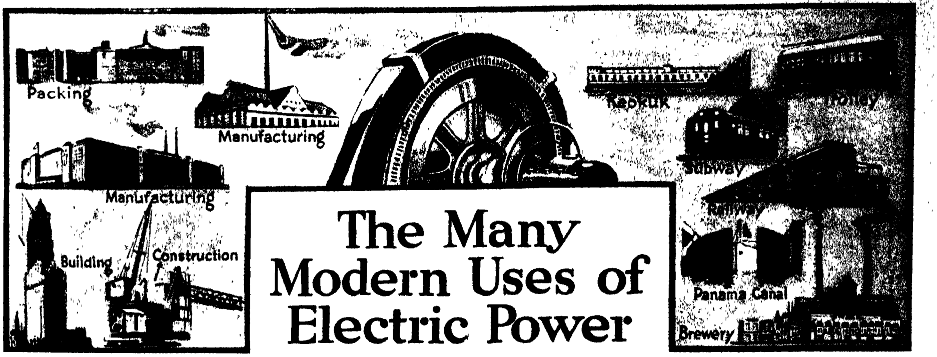
- 34-Inch Wheels
- Rayfield Carburetor
- Invisible Hinges
- Streamline Body
- Tapered Bonnet

Chalmers Motor Company, Detroit



The Many Modern Uses of Electric Power

FROM one end to the other of this busy country electricity has been demonstrating its pre-eminence as the smoother and the booster of business. In large manufacturing plants and small, in production centers of an immense variety, in public works and private enterprises—in every situation where POWER is needed—electricity has been proving its twentieth century utility. It has increased light and good cheer by eliminating line shafting and substituting individual motor drive. It has reduced fire dangers and insurance rates, and accident danger to workmen. It has promoted cleanliness. It has reduced power costs and proved its economy in related ways by simplifying operation, eliminating complexities in labor.

The Curtis Turbine has become a strong factor in power generation and the great range of G-E Motors has enabled these splendidly modern devices to meet all the intricate requirements of power transmission today. The partial list on this page will suggest the remarkable scope of usefulness in G-E apparatus.

Amoskeag Mfg. Co.
Manchester, N. H.—Largest cotton mill in the world—produces 60 miles of woven cloth an hour uses G-E Motors throughout.

Anheuser Busch Brewing Co.
St. Louis. Mo.—G-E Motor drive is used extensively in this well known brewery.

Buick Automobile Co.
Flint, Mich. When operating at full capacity this plant can produce a car a minute. G-E Motors used of course.

Cascade Tunnel,
Great Northern R. R.—G-E *Electric* Locomotives haul the trains through this famous tunnel.

Catskill Aqueduct,
New York City's water supply—practically all the electrical equipment used in constructing this famous aqueduct was furnished by the General Electric Company.

Great Southern Lumber Co.
Bogalusa, La.—Largest lumber mill in the world uses G-E Motors exclusively.

Indiana Steel Company,
Gary, Ind.—Hundreds of thousands of horse power from G-E Motors in this largest steel mill in the world.

Mississippi River Power Co.
Keokuk, Iowa—Largest power generating equipment in the world—G-E Electrical equipment throughout.

New York City Traffic—
No steam locomotives are allowed on Manhattan Island. G-E Electrical equipment is used by the N. Y. Central, the Interboro Elevated and the Hudson and Manhattan Tubes.

Panama Canal—
G-E Motors have helped to build and will operate the finished canal.

"Round the World"
-Every year the General Electric Company puts out enough railway motors to operate an electric belt line around the world.

Universal Portland Cement Co.
Buffington, Ind.—Operated by power furnished by G-E Motors.

Warner Sugar Refinery Company,
Edgewater, N. J.—Uses G-E Motor power extensively for all operations in connection with the refining of sugar.

The Guarantee of Excellence on Goods Electrical

Trade Mark

Wood Worsted·Mill—
American Woolen Company, Lawrence, Mass.—G-E Motors used throughout this largest Worsted Mill in the world.

Woolworth Building,
New York City—Highest office building in the world erected by G-E Motor-driven hoists.

GENERAL ELECTRIC COMPANY

Largest Electrical Manufacturer in the World

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For Canadian business refer to Canadian General Electric Company, Lt'd, Toronto, Ont.

SEVENTIETH YEAR

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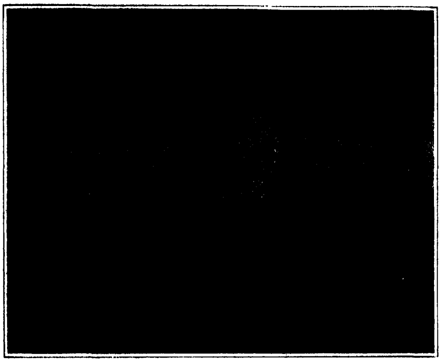

Fig. 1.—A waterspout located out in the ocean, about eight miles from Beaufort, N. C. The spout is almost vertical.

Fig. 2.—The same waterspout, its inclination being less vertical. The altitude of this meteor is two thousand feet.

Waterspouts

THE accompanying photographs show a waterspout observed near Beaufort, N. C., in the early part of August, 1911. It was one of four or five seen on the same afternoon in the same general region. At one time three of these rather rare phenomena were in view at once, but when the pictures were taken the two smaller ones had broken.

As nearly as could be ascertained, the base of the spout was located out in the ocean some six or eight miles from Beaufort. Its height, which was calculated from the size of the photographs taken with an eight-inch (focal length) lens at an estimated distance of six miles, was about 2,000 feet. It remained in view for nearly half an hour and, before it finally disappeared, nearly the entire population of the city had assembled at the water's edge to see the remarkable sight.

According to the fishermen, waterspouts are not uncommon during the late summer, but they very rarely assume the immense size of this one or have its sharply defined outlines. It is still more unusual for one to remain so long unbroken.

The day on which the observations were made was not different, perceptibly, from other summer days until late in the afternoon, when very heavy storm clouds began to gather in the west. They moved slowly eastward, and, when they had come to cover about three fourths of the western sky, a slender waterspout was seen in the far distance, looking like a column of smoke from some factory chimney. It broke soon after it was first seen.

It was next noticed that a pencil of cloud much nearer at hand, was gradually extending itself downward. Its progress was very slow, and at times it became so attenuated that it seemed to consist of separated pieces. As it approached the water it became slightly thickened, and when it finally appeared to reach the surface of the ocean, its outlines became sharply defined. A great cloud of vapor surrounded the foot and large masses, looking like the steam puffed out by a locomotive, slowly traveled upward to be lost in the tumbling mass of clouds at the upper end of the spout. The upper end was of considerably greater diameter than the middle of the column, but there was very little evidence of the violent rotary motion or the swift rush across the water that the books usually describe. A slow swaying of the column from side to side was all that could be noticed. A closer view, however, would doubtless have shown that the rotary and progressive movements were very rapid At times the column would become very tenuous, but the next minute would again become thick and dark After about twenty minutes had elapsed it gradually became thinner and thinner, broke, and the upper third was slowly drawn upward while the lower part was dissipated by the wind A heavy rain followed almost immediately

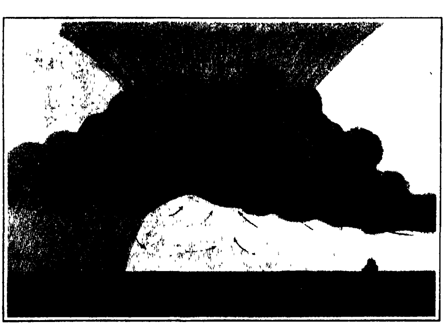

Fig. 3.—Cross-section of a thundersquall (after Arrhenius), showing the circulation of the air currents about a horizontal axis. According to Wegener, if the end of the whirl assumes a more or less vertical position it constitutes a "spout." A violent "spout" on land is a tornado.

Many popular delusions prevail on the subject of waterspouts: as, for example, the belief that they are actual columns of water, sucked up from the sea, and that they may be dissipated by firing a cannon ball through them. These and other errors were fully discussed in the SCIENTIFIC AMERICAN of June 10th, 1911, page 564.

When a French or German writer has occasion to refer to the class of atmospheric whirls to which belong the waterspout, landspout, and tornado, he calls them by the convenient generic name *trombes* (French) or *tromben* (German). The equivalent English word "spout," which was in common use in this sense a hundred years ago, is now so rare that a writer hesitates to use it, without an explanatory note. The French word *trombe* has often been borrowed by English writers, but is hardly in current use The revival of the word "spout" in scientific and general literature is a desideratum

Dr Alfred Wegener of Marburg has recently published in the *Meteorologische Zeitschrift* a novel hypothesis as to the origin of spouts The fact that these whirls begin in the upper air, and are not primarily due to conditions prevailing at the earth's surface, has long been known to meteorologists, though inaccurate statements on this subject are commonly met with in *soi-disant* scientific literature There is no indraft of the lower air from all sides, as in a cyclonic storm, the spout works downward from the clouds, and if it extends as far as the surface of the land or the sea it disturbs the air over only a small horizontal area just below it

Dr Wegener believes that the spout is always merely the attendant of a thundersquall, i e, an atmospheric whirl on an elongated horizontal axis The end of such a whirl is, according to this view, sometimes tilted downward until it reaches the earth, constituting a spout It is pointed out that the axes of spouts are usually inclined at a considerable angle, rather than vertical Even when the position of the axis approaches the vertical, it is often seen to be inclined in its upper portion toward the neighboring thunderstorm, a physical connection with which is thus suggested

There are few trustworthy observations of the direction in which the air rotates in a spout Inspection of the *debris* left by a tornado furnishes the only satisfactory evidence on this subject, and on this basis it has generally been believed that there was no constant rule for the rotation of a spout, as there is for that of a cyclone As the wind in a thunderstorm blows outward from the front of the storm at the ground, curves upward, and finally blows back into the storm to complete its circuit, if Dr Wegener's hypothesis is correct, the direction of the spout's rotation will depend upon whether the spout is formed at the left or the right side of the thunderstorm In the northern hemisphere spouts will usually form on the left side of thunderstorms. The right-hand deflection of the winds with ascent causes the storm to build itself toward the right and die out to the left, but a vortex, instead of participating in the bodily movement of the latter, is left behind as the storm shifts sideways.

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The Editor is always glad to receive for examination *illustrated* articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Extensions of the Food and Drugs Act

ONCE upon a time the histrionic exhibition of candor on the part of a certain soap-making concern which announced that its product was only "99½ per cent pure" attracted considerably more attention than far more damnatory confessions of the same nature do to-day.

The Food and Drugs Act in these United States, and analogous legislation in other countries have wrought a remarkable revolution in the attitude of the public toward many things that were once regarded as "impurities" and "adulterants," and were accordingly in strong disfavor. Artificial coloring matter, preservatives, and the like have been to a certain extent robbed of their terrors. But the end is not yet. The last report of the United States Bureau of Chemistry traces the operation of two recent amendments to the Food and Drugs Act, which not only are significant in themselves, but open up new vistas to the student of practical ethics. The Sherley amendment, enacted August 23rd, 1912, deals with medicines branded with false and fraudulent statements concerning their effects on disease. Hundreds of these preparations have been analyzed by the chemists of the Bureau. As a result seizure of several preparations was recommended, and the prosecutions which followed were all won by default. Already a vast improvement in the labeling of medicines has resulted. The long familiar claims, "a sure cure," "a reliable remedy," etc., are being replaced on the labels by much more modest statements, such as "will be found beneficial in" or "will relieve many of the symptoms of." Fewer nostrums than formerly are alleged to be cures for such serious diseases as tuberculosis and cancer. The second amendment, known as the net-weight act, which dates from March 3rd, 1913, requires that all packages shipped in interstate commerce shall be plainly and conspicuously marked to show the quantity of the contents. Although effective from the above date, this law provides that no penalties shall be imposed for 18 months, and the Bureau confesses that it may be years before all the necessary data have been collected to insure equitable enforcement. Elaborate studies are now being made of such problems as shrinkage, variation of containers, errors in weighing, measuring, and counting by hand or machinery, i. e., the factors that may defeat the best intentions of the manufacturer to comply with the provisions of the law. For the study of shrinkage, experimental shipments of a great variety of goods are being made to detect changes in weight and bulk due to variations in temperatures and humidity, and the normal water content of foods is being investigated.

The Central Electric Companies' Problem

THE central electric companies have lately awakened to face a serious problem, the successful solution of which is essential to their future welfare.

The typical central electric company, a public service corporation, has but few electric generating stations. These, however, are large and economically located, usually on a river bank, so that water and coal costs, which are large factors in generating cost, may be reduced to a minimum. The prime movers are of the most efficient, and therefore most expensive type. Automatic devices, conveyors, etc., reduce the operating force to a degree that is surprising to the uninitiated.

At first glance one who had not investigated the proposition, would say instantly that a small private plant could not compete with a central plant such as is outlined above. If relative generating costs were the only consideration the private plant would at once be tabooed. The real features to be considered, however, are "What will it cost to generate the required power in a private plant?" and "At what rate could this power be purchased from the central electric company?"

The cost of generation, or power plant operating expense, represents less than twenty per cent of the expenses of the central company. The other expenses include taxes on property and lines, electrical losses on the company's lines (about one third the power sold because of leakage, etc.), interest and depreciation on equipment, advertising expenses, selling charges, uncollectable bills, and interest on bonds and stocks. The private plant expenses include only interest and depreciation on equipment, and cost of operating plant.

The above statements explain primarily why the private plant of a large building can compete with the central power company, but there is a secondary reason which is quite as important. A large amount of steam is required in large office buildings, apartment houses, hotels, etc., for various purposes. The heating system requires steam for approximately half the year, and the laundry, the cooking and refrigerating systems of the restaurant, and the hot water service require steam throughout the year.

Strange as it may seem, a private power plant supplying electricity and exhaust steam for the above purposes requires but little more coal than would be required for boilers supplying only the steam required for the building, no electricity being generated. This fact is due to the large amount of energy in the exhaust steam, the engine utilizing only about five per cent. The highly efficient engines of the central power company utilize about 17.5 per cent of the energy in the steam, or in other words, the private plant requires three and a half times as much coal to generate electric power as the central company. Add to this the greater coal, water, and attendance charges for a small plant and the two propositions appear to be on a par if only the electricity is considered.

If, however, electricity is purchased from the central electric company, boilers must still be operated to supply the necessary steam for the building. Much of this steam could be obtained from the engine exhaust of a private plant, and that is why the private plant of a fair-sized building is a paying proposition.

Allowing for the cost of operating boilers to supply the steam for the building, the cost of electricity for the year with a private plant of fair size would be only 40 to 70 per cent of the cost of electricity purchased from a central electric company.

That the actual condition of affairs is known to building managements is shown by the following statistics published in technical journals of recent years.

Buildings—Per Cent Having Private Plants.

Office buildings of twenty-six cities	63
New York buildings over eight stories high and occupying area over five thousand square feet	70
New York hotels, two hundred rooms or over, more than ninety in number	95

Many large buildings would install a private plant, but owing to the layout of the building, etc., a private plant never having been considered when they were constructed, they are limited to a heating plant.

The central electric company's field is limited to the buildings just mentioned and the small consumers. The problem of the central electric company is to increase its field of operation, or expressed in other words, to reduce the price of power to the consumer and yet obtain a good profit.

Two propositions are being considered by central electric companies to bring this about. The first is to use the exhaust steam of the engines of their plants for the manufacture of ice. Objections may be made to this on the ground that in winter, when the demand for ice is a minimum, the load, and therefore the amount of exhaust steam to be utilized, is a maximum. In summer these conditions would be reversed. Granting, however, that the ice plant would pay the operating expenses of the electric generating plant, the price of power to the consumer would not be radically lowered, for, as already stated, the cost of generation is less than 20 per cent of the expenses of a central company.

The second proposition considered is to establish a number of small power plants in buildings in the business section of the city and sell both electricity and heat to the surrounding buildings. A plant of this nature could not be operated more economically than a private plant, and would have the additional expense of its share of the advertising, selling, loss by uncollectable bills, and interest on the bonds and stocks of the company. The capital necessary to carry out this scheme would be enormous, as it would mean the complete revision of the electrical system, and as is indicated above, its efficacy would be very doubtful.

Evidently neither of the above plans is a successful solution for the problem, and even though the central electric companies should go into the ice business, the private power plant would still be a good investment for a building of reasonable size.

Economy in the Philippine Weather Bureau

THE ways of the powers that be in dealing with scientific institutions often give rise to extraordinary situations. The latest illustration of this fact comes to us from Manila, where on December 18th the veteran director of the Philippine Weather Bureau, Father José Algué, appeared before the Philippine Commission and, after pleading for two hours, succeeded in persuading that enlightened body not to impose upon the staff of his bureau a choice between starvation and the abandonment of their work. A poignant climax was reached when the director, who, with all his scientific skill and learning, is the embodiment of simplicity and sincerity, offered to relinquish the whole of his own salary, if his faithful subordinates might thereby be saved from a reduction of pay; an offer that is recorded to have produced "heart throbs" among his official auditors. The scene is thus described in a Manila newspaper:

> "It was a picture not soon to be forgotten by those who were present at the afternoon session of the Commission yesterday. It was the picture of a man who has devoted his life to a great work, who has sacrificed much that he might benefit not only the Philippine Islands, but the whole world by the results of his researches. It was the picture of Father Algué pleading with the law-makers that the work which has meant so much might continue and that, at his own sacrifice if need be, some trifling recognition of faithful services be accorded to his subordinate co-workers."

As everybody knows, the policy of the new administration in the Philippines is to reduce the expenses of government; in other words, official salaries. It is not yet clear just how the present upheaval is going to affect the large and able body of scientific workers who have been attracted from America and other countries to take service under the Philippine government, and accordingly we refrain for the present from discussing this phase of the subject. The employees of the Philippine Weather Bureau, however, are in a class by themselves. They may be regarded as permanent inhabitants of the Philippines and are not influenced by mercenary considerations in the choice of their field of labor. The director and a few of his chief assistants are Jesuit priests; the rank and file are natives.

The institution which ultimately became the Manila Observatory was founded by the Jesuits in 1865, and from the beginning has devoted itself especially to the task of protecting the islands from typhoons. Numerous outlying stations have been established from which reports are telegraphed daily to the observatory, where they are charted with reports from stations in Japan and on the China coast. Far to the eastward telegraphic outposts have been established in the islands of Guam and Yap. With its broad outlook, the mature experience of its officials, and facilities for rapidly issuing warnings by wire and wireless, not only to all parts of the archipelago, but also to vessels upon the high seas, the observatory is recognized throughout the Far East as an absolutely indispensable means of safeguarding life and property from the dreaded typhoons, of which, in an average year, about twenty-five actually enter the Philippines, to say nothing of many others which sweep across the adjacent seas. Incidentally, this meteorological service has compiled the climatic statistics necessary for placing scientific agriculture in the Philippines on a sound basis; has made a systematic study of earthquakes, volcanoes, and terrestrial magnetism in the islands, and maintains work in practical astronomy.

After the American conquest the observatory and its network of stations were taken over by the new government, without any changes of personnel or organization, and were known thereafter as the Philippine Weather Bureau. The service is not in any way connected with the Weather Bureau of the United States.

The cost of maintaining this service, which was acquired without *any* initial expense, has been modest to the verge of absurdity. Especially in the matter of salaries has the history of the Philippine Weather Bureau been such as to delight the most parsimonious dispenser of public funds. In spite of a trifling increase in 1911, the average salary paid to each of the eighty-three employees who constitute the meteorological division of the service, counting in the relatively magnificent stipend of $2,500 drawn by the director, is approximately $385 a year. Some of these men have served for twenty-five years. All have proved faithful in the performance of arduous duties requiring more or less technical skill. Last but not least, if they should suspend their labors the unpreparedness of the islands for the first storm that came along might conceivably cost more in devastated property, not to mention the loss of life, than the entire expense of operating the bureau from its foundation to the present time.

Yet Father Algué only persuaded a thrifty legislature not to *reduce* the salary fund of his bureau!

Science

A Memorial to African Explorers.—On November 21st Lady Scott, widow of the Antarctic explorer, unveiled a tablet in the parish church of Cranbrook, England, to the memory of Lieut. Boyd Alexander and Capt. Claud Alexander, who lost their lives while exploring in Africa three years ago.

Spread of Gypsy Moth by the Wind.—Experiments conducted by the U. S. Bureau of Entomology prove that the newly-hatched caterpillars of the gypsy moth may be blown, under favorable conditions, a distance of six miles or more. Thus the wind is an important factor in the spread of this destructive pest.

Elliott Cresson Medal for Molecular Air-Pump.—The Franklin Institute of the State of Pennsylvania has awarded its Elliott Cresson Gold Medal to Prof. Dr. Wolfgang Gaede for his molecular air-pump, in consideration of the very great value of this invention for the quick production of vacua beyond those hitherto obtainable. A description of this pump appears on another page.

The "Fram," the most famous polar exploring ship in the world, will not, after all, have the honor of being the first vessel to pass through the Panama Canal. After waiting at Colon since October 3rd, she has now started south on the long journey to the Pacific *via* the Straits of Magellan. It was feared that an indefinite delay at Colon might prevent her from reaching San Francisco by the time Capt. Amundsen plans to start for the Arctic regions next Summer, in which case the expedition would have to be postponed for a year.

Pellagra and Stable Flies.—It is now generally supposed that pellagra is carried by some biting insect, and the buffalo gnat, among others, has been suspected. Investigations recently carried on in Spartanburg County, S. C., by the U. S. Bureau of Entomology and the Thompson-McFadden Commission of the New York Post-graduate Medical School, practically exclude the possibility of transmission by the buffalo gnat, but tend strongly to show the possibility of transmission by the stable fly, already known to be the carrier of several other diseases.

The Canals of Mars.—Prof. Lowell telegraphs to us from Flagstaff, as follows: "The canals of Mars are now exhibiting a very striking seasonal development from north to south over the planet surface, being darkest and strongest near the edge of the melting north polar snow cap and thence gradually pushing farther and farther southward. This is exactly in accordance with what the Lowell Observatory has predicted for their behavior from its extensive and critical study of the planet, and is corroborative of Lowell's theory. This observed development of the canals is somewhat similar to the annual inundation of the Nile."

The International Catalogue of Scientific Literature, published annually, in seventeen volumes, each devoted to a particular science, has recently completed its tenth year of publication and is regarded as an indispensable part of the working equipment of scientific libraries throughout the world. Although the volumes are issued by the Royal Society of London, the undertaking is truly international, representing the co-operation of 32 governments or national institutions. The committee of the Royal Society which has the oversight of this work is also engaged in completing the great Royal Society Catalogue of Scientific Papers, which covers the scientific literature of the nineteenth century and of which subject-indexes are in course of publication. All scientific workers will be dismayed to learn that there is grave danger of the suspension of this splendid bibliographic undertaking on account of lack of funds. An international subscription ought to be started at once to prevent such a calamity.

Improvements in Meteorological Instruments formed an important part of the work of the Weather Bureau during the last fiscal year, according to the annual report of the Bureau recently published. Investigations of anemometers were carried on with a view to the standardization of these instruments for measuring high wind velocities. A large motor-driven whirling machine having a horizontal arm 30 feet long and capable of being driven at all velocities up to 75 or 100 miles an hour, measured at the end of the arm where the anemometer is installed, was used for these tests at Mount Weather Observatory. Valuable data have been secured, but the investigations have been temporarily interrupted by the appointment of the official who was conducting them to the position of Chief of the Weather Bureau. Important progress has also been made in the revision of psychrometric tables. The most interesting instrument devised during the year was an automatically recording rain-gage, which can be left without supervision for a period of eight days and will make an accurate record of the rainfall during that period. An instrument of this character has been urgently needed for installation in places where it is impracticable to station a resident observer.

Automobile

Seats Heater in the Steering Wheel.—A steering wheel having in its face a recess is provided with a closure for the recess and an electrical heating unit is carried by the closure within the recess, the same being shown in a patent No. 1,082,830 to Rubin S. Smith of Marshall, Texas.

Air-brake for Motor Trucks.—An air-brake, so called, has been added by the manufacturers of a French motor truck as part of the regular equipment. The device is not what is generally understood as an air-brake in this country. It is more of a dynamometric fan, or fan-brake, similar to the mechanism employed in striking clocks. When the motor truck is on a long down grade on which continued application of hand or emergency brakes would burn the brake lining, the driver pulls the "air-brake" lever. The revolving shaft acts by means of a bevel gear upon a wide-bladed large fan mounted horizontally below the body of the truck. The resistance of the atmosphere to the forward motion of the fan blades retards the shaft revolutions sufficiently to brake the truck. Objection to the device has been raised because of the great tendency to whirl dust upward against the truck.

A New Binary Automobile Motor.—Something entirely new in the application of the binary vapor principle to automobile engines has been brought out by an English inventor. Condensed into its vital facts the new device is a four-cylinder motor in which the cylinder nearest to the radiator has been supplanted by a steam cylinder. The cooling water of the gasoline motor, when heated by the cylinders, is led into a compressor and subsequently forced into the steam cylinder where it is charged under pressure with the hot exhaust gases from the three gasoline cylinders. The pressure of the now superheated steam-gas mixture forces down the piston in the steam cylinder, which piston is connected to the crankshaft by the usual connecting rod. In effect the new motor is an engine with three cylinders of the internal combustion type, and a fourth cylinder in which the heat of the exhaust gases is utilized as pressure. The inventor claims a fuel reduction of about 20 per cent and a steadier running of the engine.

Power Consumption of Electrical Apparatus.—Since the general introduction of electric lighting and engine starting equipment on the modern automobile, the question of its power consumption has been a moot one. Manifestly, the figure must vary with varying equipment, and with different cars, but much light has been shed on the question by a number of tests recently made on the Long Island motor parkway. The tests were made with a six-cylinder five-passenger touring car weighing 4,862 pounds "all on" and driven with top up, windshield in place and side curtains on. The illuminating equipment consisted of ten lamps which were kept burning. The test was conducted by the Automobile Club of America. Four runs were made, two at 20 miles an hour with the generator in action and out of action, respectively, and two at 40 miles an hour under the same conditions. Briefly, the results revealed that whereas 7.3 gallons of fuel would drive the car 100 miles at 20 miles an hour with the generator not running, 7.6 gallons would be required with the generator in operation, at 40 miles an hour the gasoline consumption per 100 miles, without the generator running, was 8.7 gallons, and with the generator in operation, 9 gallons. The difference in fuel cost per 100 miles, at the average rate, is approximately six cents.

France Offers Prizes for Kerosene Engines.—By way of stimulating the use of kerosene as a motor vehicle fuel, for which the French automobile industry is convinced there is a great future, the Automobile Club of France, located in the French capital, is to hold a series of tests of kerosene engines commencing October 1st next, with prizes to aggregate $12,400; the first prize is $10,000, the second $2,000, and the third $400. The test is not a carbureter test, but is designed to demonstrate the usefulness, fuel consumption, etc., of four-cylinder engines rating between 20 and 30 horse-power, of the automobile type. Each engine entered, for which the fee will be $30 prior to April 1st and $60 after that date and up to July 1st, must not weigh more than 33 pounds per horse-power exclusive of fuel and water tanks. Engines can be started on gasoline, provided this fuel is not contained in a tank that forms part of the equipment. There will be four bench tests— three hours each at full and half load, two hours half full speed and two hours light—during which the fuel consumption must not exceed (for qualification) 350 grammes per horse-power hour. Subsequently, the engines will be placed in chassis the minimum weight of which is to be 14,040 pounds, for road trials which will cover four days, in which the vehicles will be driven 620 miles at an average speed of 19 miles an hour. Throughout the tests, paraffin having a density of 810–820 and a flash test (Granier instrument) of 35 degrees, will be supplied to contestants. Points from 0 to 20 will be awarded for performance, fuel economy and general operation, etc.

Astronomy

The Light of the Earth.—It has been remarked that the globular light from the whole sky is superior to the sum of all the quantities of light sent to us separately by the stars. Even the most sombre regions seem lit by a diffused light which truly has its origin in the terrestrial atmosphere. It is the light of the earth. Different people have endeavored to evaluate the intensity of this earth light and have found that it is of the order of one tenth part of the intensity of a star of the first order of magnitude. It is attributed, at least partially, to a permanent aurora borealis which is revealed by the characteristic green ray which is observed on obscure nights in the whole heavens. There is probably something else: the continual bombardment of the upper atmosphere by meteoric swarms and cosmic dust may also illuminate. The mass of meteoric matter which would suffice to explain the observed phenomena has been calculated and the figure found is in good agreement with that given by a direct calculation of the quantity of cosmic matter which strikes the earth.

Stars of Class B.—Stars of which the spectra are particularly marked by the lines of helium and hydrogen are designated as class B in the Harvard classification. The general opinion is that these stars are very hot, that they are of great mass, with a high pressure in the atmosphere that surrounds them. They are also regarded as very young in the order of their evolution; being preceded in this respect only by the stars of class *O*, which comprises relatively few stars. As the result of detailed researches by P. W. Merrill, it appears that the distribution in the heavens of stars with brilliant lines accords with that of all the stars of class *B*; they are even relatively more numerous among the stars of class *B* superior to the fifth order of magnitude, which seems to indicate that there is a greater chance of encountering stars with brilliant lines among the very big stars. There are also cases, the most remarkable being that of the Pleiades, where a certain number of these stars seem very closely grouped, and it is difficult to admit that these groupings are fortuitous.

The Constitution of Comets.—Great diversity of opinion has prevailed on the subject of the physical constitution of comets. It has been maintained, by different astronomers, that the nucleus of a comet is solid, is liquid and is gaseous. If we agree with Schiaparelli and see a relation between comets and the swarms of meteorites, it is difficult to avoid the conclusion that a comet is a cloud of solid particles, and we return to the theories of Prof. Newton, who regarded comets as veritable "sand-banks." What are the dimensions of these constituent particles? We do not know; we can only say that in all probability they vary in size from a grain of dust to a body of several cubic yards. However this may be, the particles are certainly separated from one another by great distances, and, speaking on a small scale, we may liken a comet to a number of particles about the size of a pin's head at distances of some hundreds of yards. Each particle carries with it a gaseous envelope formed principally of a substance furnishing a spectrum analogous to that of the hydrocarbons. Under the action of the sun, and perhaps through some electrical effect, the envelope becomes luminous or phosphorescent. This view of a comet's structure explains the fact that even the feeblest stars may be seen through the cometary cloud, without suffering either appreciable diminution in brightness or refraction.

The Age of the Earth.—Certain colored minerals, in particular certain micas, when examined microscopically, present dark stains in the form of a disk. At the center of each stain is a little crystal, usually a crystal of zircon which has been included at the moment of formation of the mica. The explanation of these dark stains is to be found in the fact that the zircons are strongly radio-active. The radio-active crystals stain the mica in the same way as they color glass, etc. But the x-rays emitted by different radio-active substances have not all the same penetrating power, and for that reason the mica stains are usually darkest at the center. If they are old enough the stain is uniformly dark, as even the few rays which reach the outer part have had time to completely stain it. Experiments were made by Joly and Rutherford to determine experimentally the number of x-rays required to produce a given stain in mica. Measurements were made on the halos or stains so produced and they were compared with those produced naturally by the zircon crystals. The amount of uranium present in the crystal was evaluated and the number of x-rays necessary to produce the natural stain permitted one to ascertain the amount of uranium which must have disintegrated since the origin of the mineral. The theory of radio-active transformations then leads very simply to an expression for the age of the halo. The numbers obtained oscillated between 470 million and 20 million years, which is in fair agreement with the determinations of the age of rocks, although they differ from the results which have been deduced from the quantity of salt contained in the oceans.

A New Way of Throwing Messages from Aeroplanes

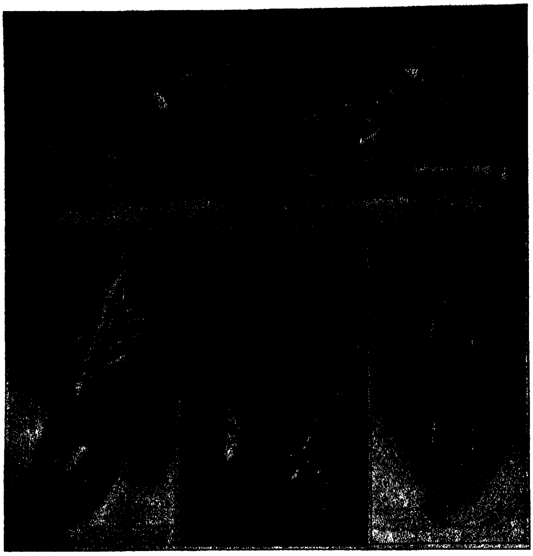
By Lucien Fournier

As the flying machine developed, the need of subsidiary apparatus became apparent. Military men soon demanded the installation of wireless apparatus, guns, armor and similar accessories. While a great deal of experimenting has been done to give them what they want, it can hardly be said that a very great measure of success has as yet been attained. Especially is this true of the wireless equipment. The sending apparatus which can be carried on an aeroplane is necessarily of very small range, and the receiving apparatus must struggle with the difficulty of interference. Some day these objections will undoubtedly be overcome, but until they are, a French inventor and aviator, Paul Fugairon, believes that some such apparatus as he has invented and tested near Brest will be more acceptable to military men. With his invention a message can be dropped in full flight by an aviator who is sufficiently near his destination, the craft returning immediately at full speed to the enemy's position There is no danger that the message will be blown away by the wind, or that it will be lost or damaged in mud, dust, high grass, and heavy foliage.

As the accompanying diagram shows, the apparatus consists of a hollow cylinder, in which the message is received. At its base the cylinder is inclosed by an ogival member *P* into which lead has been poured, so that the apparatus will always drop upon the point *P*, which passes freely through the lead. At the other end of the cylinder is a cover *L*, the top of which is formed like a lantern with four open windows *C*. Within the cover are four clamps to hold material for a Bengal fire. This is ignited by the explosion of a cap of mercury fulminate. As the apparatus strikes the ground, the cap is exploded by the firing pin *B*, which is guided in two brackets, and the flame of the explosion being conducted to the Bengal-fire material through the curved tube *U*. A lever mechanism here connects the firing pin *B* with the point *P*, the lever mechanism being held in a position of rest by the spring *R*. As soon as the point *P* penetrates the ground the spring *R* is compressed, the lever mechanism is operated to pull the pin *B* backward a short distance, and to release it immediately afterward The firing spring which was put under tension before the message was dropped, is thus liberated, so that the pin *B* is forced against the fulminate cap

The exceedingly bright Bengal fire which flashes up can be seen not only at night, but in daytime as well What is more, it burns long enough to allow a soldier who has been watching for it to cover a distance of 300 yards to the spot where it has fallen, and whither its light guides him

Obviously not only written messages, but also sketches and rough maps can be "canned" in this way


By means of this simple device messages can be discharged from an aeroplane with the certainty that they will be found. As soon as the device strikes the ground Bengal fire is ignited, and the resultant smoke indicates where the message is to be looked for.

Traveling Crane for Building Construction

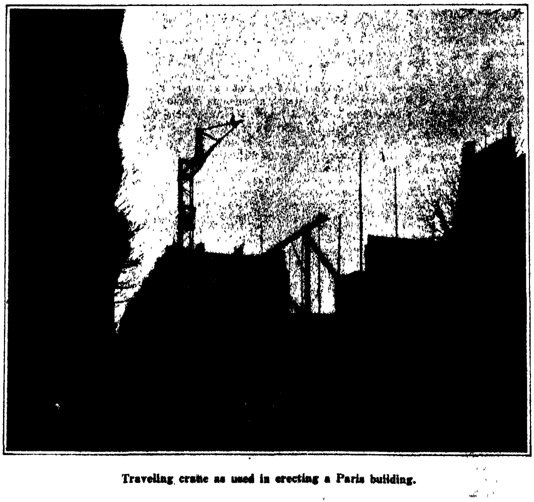
A NOVEL type of crane has been devised in France for handling materials in building construction. It consists of a lattice-steel mast mounted on four wheels, two of which run on a track placed on the ground parallel to the front of the building, and the other two on a track about forty feet above the ground. The latter is maintained in position by uprights and tie-rods secured in the mass of the building foundation. The construction is clearly shown in the engraving which represents one of these cranes in service on the Boulevard Malesherbes, Paris. The track is supported at frequent intervals, and is furnished with holes about four inches apart to provide for attaching it at places appropriate to the requirements of the building

The mast is constructed of angle iron spaced about four feet apart and stiffened with cross braces. The head of the mast carries a turntable set out from the center about four and one half feet so as to carry the load well into the interior of the building. The crane proper can make a complete revolution, thus avoiding accidents which occasionally occur in cranes that cannot make a complete turn, because in a violent windstorm the boom can set itself in the direction of the wind, like an ordinary weathervane, without coming in contact with any fixed portion of the structure.

The boom is arranged in such a way that the lifting block may be positioned in accordance with the weight of the mass to be lifted. For a weight of 1,500 kilogrammes (3,300 pounds) a reach of seven meters (23 feet) can be used, while the crane can lift 7,000 kilogrammes (15,000 pounds) at a distance of one meter (3.3 feet).

The mechanism of the crane includes in addition to the lifting gear means for propelling itself along the track and also means for swinging the boom. There are two lifting speeds operated by friction clutches. The transporting movement is accomplished by cone gearing and friction clutches. In order that the load may be properly served by the crane it is essential that the operator should be able to see the work which he is doing. For this reason the operator's cabin can be placed upon the mast at any required height, variable with the state of advancement of the work. The great advantage of this type is that it does not encumber the road. Half a meter (1.64 feet) is sufficient to secure the passage of the apparatus between the scaffolding on the one hand and the regulation scaffold on the other The height of the apparatus is variable. It has been used up to a height of 35 meters (115 feet), while the reach has been carried to 12 meters (39 feet). A special arrangement allows the use of the apparatus on an inclined path. In one case two cranes of this type were used in the construction of a viaduct on a 32 per cent slope.

In the case of a building on a corner, it is useful to be able to serve the two frontages by means of a single transporter mast crane. For this purpose a turntable has been designed, allowing the crane to pass from one frontage to the other in a few minutes.


Traveling crane as used in erecting a Paris building.

Citropsis

THIS name is given by W. T. Swingle and Miss M Kellerman to a new genus of tropical African fruits, which may be called generically in English "African cherry oranges." The species, of which there are several, were formerly assigned to the genus *Limonia*, under which they figured as the sub-genus *Citropsis* in Engler's classification. The authors above named find, however, that they are much more nearly related to *Citrus* than to *Limonia*, and this relationship opens up interesting possibilities for the plant-breeder. In their natural state some species of *Citropsis* bear an abundance of delicious fruit. Greenhouse experiments at Washington show that at least one of the species can be grafted readily on several *Citrus* stocks, while *Citropsis* serves as a successful stock for grafting grapefruit and oranges. Any new stock available for grafting citrus fruits is a lucky find, since it generally increases the range of soils adapted for the culture of such fruits and adds to the chances of combatting disease.

Whale Meat is becoming a more and more popular article of food in Japan, where it is not only sold fresh, but also canned on an extensive scale. Canned whale meat is used by the Japanese army as a field ration. The chief objection to its more general use appears to be its strongly fishy taste and odor.

A Great Brass Brain

A Unique Engine, on the Accuracy of Which Depend Millions of Dollars and Thousands of Lives

By C. H. Claudy

ROGER BACON, man of letters and of science, who lived in the thirteenth century, is supposed to have manufactured a brazen head or android, which spoke and revealed "dreaded secrets of the past and future." But no brass brain has come down to the present day from antiquity which can even think, let alone articulate through a brass mouth.

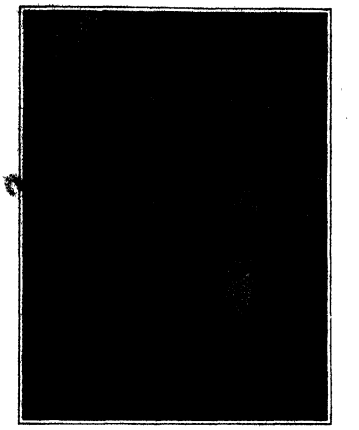
But a mechanism, built for these United States of ours, can truly be called a "brass brain," in that it does the mathematical calculations which would otherwise require a hundred flesh and blood brains to do; and if it does not actually articulate its results, at least it indicates them plainly enough, not only by dials, but by writing them down. Still more does it claim kinship with that ancient and fabled brass brain of Bacon's, in that it, too, foretells the future, though no "dread secret" does it make known.

This introduction may seem fanciful—it is sober fact. The machine is known as the United States Tide Predicting Machine, Number 2. It is in daily operation in the United States Coast and Geodetic Survey at Washington. Its work is nothing less than the predicting of the times and heights of high and low tide, a year in advance. Its mechanism is of brass and steel, its house a huge mahogany and glass case, and its tender one observer, who does but sit and turn a crank until it stops, then copies off on paper the reading of several dials, and later removes from the machine a roll of paper on which is plotted the tidal curve for the particular spot along the coast, the tides of which have been predicted.

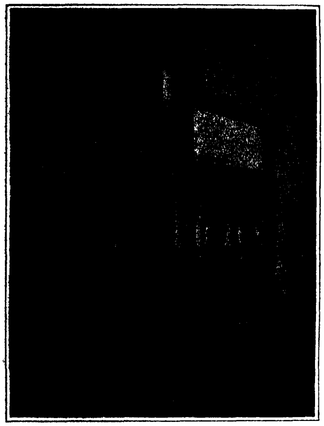
Every year the United States issues a fat book of Tide Tables, primarily for the use of its navy, and secondly for the use of all who go down to the sea in ships. This book of Tide Tables gives the time to the minute and the height to the nearest tenth of a foot of every high and low tide during the year for seventy of the great world seaports, and by means of an auxiliary table, the same information for 3,000 other places.

It is essential for the mariner to know when tide is high and when low, and the magnitude of the tide. The safety of his ship and the lives of all on the vessel may depend on that information being accurate and reliable. So that when it is a question of predicting for some day in the future, just when high water will be reached in New York harbor, or when low tide will occur in the Golden Gate, and just how high or how low the tide may be, you can be very sure that the machine which prophesies is an accurate if complicated machine. That it is a wonderful machine may be imagined. It has over 15,000 parts, but so carefully is it made that lost motion is reduced practically to zero. Unlike the human brain, this one of brass cannot make a mistake. How wonderful this is, it is difficult to conceive without some knowledge as to how a tide is actually produced and how it would be predicted by the use of pencil and paper alone—the oldest way known, and also the longest and least accurate.

As most people know, the tides are the names we give to those periodical risings and fallings of the ocean which occur daily. They are produced by the action of the force of gravitation between the sun and moon and earth. The tides are thus the result of forces which come under observation of the astronomer, and it is astronomical data which is used in predicting a tide.



Where tidal component differences are gathered together.



Front view, showing controls, dials and tidal curve plot.

Side view of the tide recording machine, showing the pulleys and chain that govern the movement of the pen.

If the earth was a perfect sphere, covered all over with water to a uniform depth, if the earth went around the sun in a circular path with the sun in the center and the moon went around the earth with a perfectly uniform motion and if sun, moon and earth were always in the same plane, tide prediction would be a simple matter of mathematics; the heights of a tide for all ports in any one latitude could be made together

But the earth is *not* a perfect sphere. It *isn't* covered with water to a uniform depth, it has many continents and islands and sea passages of peculiar shapes and depths, the earth does *not* travel about the sun in a circular path, and earth, sun and moon are *not* always in line. The result is that two tides are rarely the same for the same place twice running, and that tides differ from each other enormously in both times and in amplitude

For many years tide predictions were made, entirelv by manual and mental labor, and because of the complication of the matter, but few of all the causes which enter into a tide were considered in actually predicting how high a tide would be, and when it would be in flood.

But Sir William Thompson now Lord Kelvin, revolutionized matters when he devised what he termed a system of "harmonic analysis." It is evident that if a pencil be made to rise and fall as the tide rises and falls, on a vertical sheet of paper which moves under the pencil, a curve will result. It is also evident that if a sufficient number of observations are made to get rid of those tides which are late or early because of wind, or high or low because of freshets on land, the remaining tide curves, if averaged, will bear a definite relation to the actual tidal causes Sir William Thompson found that he could analyze these tidal curves.

He began by imagining a fictitious sun, which moved evenly in a circular path about the equator at a uniform speed. The real sun doesn't move that way at all But the theoretical sun, being a figment of the imagination, did as it was told. To this obedient sun was added another sun which moved differently, and still another moving still differently, and so on, until a very respectable number of imaginary suns were circling about the earth. These suns were all so calculated that the sum total of their attractions and movements equaled the sum total of the attractions and movements of the real, sure enough sun! Instead of having one sun in an irregular number of positions and distances, Lord Kelvin imagined a number of perfectly regular suns, which did what they were told as to unvarying motion, but which, when combined, equaled our own irregular sun

The same thing was done for the moon; and behold a whole lot of definite, regular, undeviating mathematical factors, *all together equaling the puzzling irregularities* of our real sun and moon, but separately so well behaved that they could be used all the time as components of a mathematical equation which would demonstrate a tide

All the most important of these theoretical suns and moons, or components of the tides, as they are called, were computed by Sir William Thompson and extended and improved by Sir George Darwin, brother of the great Darwin Since that time, these components of the tide have been computed for practically all the important tide stations in the world and are common property.

It didn't take Sir William Thompson long to figure out that if harmonic analysis could predict tides from data gathered from an observed tidal curve, then the components which could be extracted from a given position of sun, moon and earth ought to be able to be put into a tidal curve. From this was but a short step to actually making the first tide machine, which took account of but ten components of a tide, but actually plotted a predicting tide curve

This first tide predicting machine was followed at intervals by four others, two for England, one for France and one for Brazil But conceiving a tide machine is one thing, making one practical, another, and all the various machines failed to take account of any great number of tidal components Then came Prof. William Ferral of our own Coast Survey, who, in 1881, designed a tide predictor which was used by the Coast Survey for twenty-seven years It was the first tide predicting engine to show on dials on its face the time of day, time of year, height of tide, etc Instead of producing a tidal curve, it required only that an observer copy off the data to have it ready for the printer. All the other machines had traced curves from which a calculator had to work, digging out, literally by its roots, the data in numbers, from the curve in front of him.

The underlying principle of all these tide predicting machines has been the same—the summing up mechanically of a number of different motions, actions and reactions. The means is a slender chain, passing over pulleys, each of which is mounted on a shaft or crank The crank is adjustable, so that it can be made more or less eccentric with the shaft itself The degree of eccentricity represents the amplitude of the particular component (or imaginary sun or moon) of the tide under consideration. When the machine is operated, the various cranks revolve, and the chain which passes over them all is pulled upon by some and allowed to become slack by others The movement of the end of the chain, then, becomes the sum of all the movements of all the components in the machine, each represented by a crank, adjustable on a dial.

By attaching the end of the chain suitably to a pen, and by having a moving sheet of paper beneath the pen, the machine traces the tidal curve. The principle of this mechanical summation is illustrated in the diagrammatic sketch, in which five component slides are shown Reference to the photographs will show how these are operated; an adjustable steel crank-pin on each disk or wheel works in a horizontal slide in a light steel frame, an extension member of which terminates in a pulley, *C*, *D*, *E*, *F*, and *G* Passing over and under these pulleys is the steel chain of the apparatus, one end of which is fixed (4 in the diagram) and the other end of which is suitably connected with a movable pen *B*, which plays against a ribbon of paper that passes beneath it.

If we suppose the disks 1, 2, 3 and 4 in the diagram are fastened and stationary, and imagine a counterpoise weight connected to the chain beyond the pen *B*, then it is obvious that if the disk 5 revolves and at the same time the ribbon of paper passes from right to left under the pen, a true harmonic curve will be produced as in the line *ZZ* (of course the curve will be a solid line in practice; dotted lines are here used for clarity).

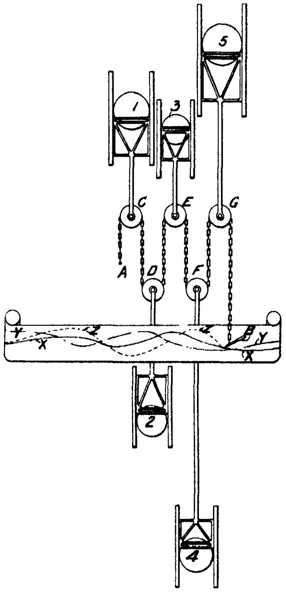
If now we suppose the disks 1, 2, 3, and 5 to be fixed and immovable, and disk 4 to revolve, another type of curve will be produced on the moving sheet of paper, as in the curve *YY*.

Now if disks 1, 2, and 3 be kept fixed and immovable, but disks 4 and 5 are permitted to revolve, then the curve traced upon the paper will be the sum of the two curves *ZZ* and *YY*, as shown in *XX*. If all five of the disks revolve, then the resulting curve will be the sum of all their curves individually.

If each disk in its speed of revolution represent the effect of motion of a lunar or solar component of a tide, and each crank on each disk is set so that its distance from the center represents the amplitude of such motion, then each disk, crank and slide truly represents a *factor* of a tide—the effect of one of the fictitious moons or suns, the sum total of the motion of which expresses the tide itself.

The Ferral machine was wonderful and accurate for a while. But it wore badly with years of use, its slender shafts were not sufficiently rigid to keep an *error of torsion out of the results, and it was decided* after twelve years that a new machine, better and quicker, more accurate, and more reliable, should be made.

Mr. E. G. Fischer worked upon the Ferral machine Later he became Chief of the Instrument Division of the Survey. When it was decided to build a new machine, it was to Mr Fischer that the authorities turned. *He designed a new machine, and after the plans* were accepted, went to work Only such time as could be spared from the regular work of the Instrument Division was put into the new machine, which was fifteen years in building. But now it is finished, and stands forth as the most remarkable, most accurate and most complete machine of its kind in the world. It takes account of thirty-seven factors or components of a tide. It is truly American in its design, for not only does it do what all the foreign machines have done, plot a tidal curve by pen and ink, but it does also what the Ferral machine did—presents the results on dials for visual reading. It not only gives the times of high and low tide, but shows by a time line on the tidal curve sheet the hours, so that the state of the tide at *any* time can be readily computed



How the curves are summed up mechanically.

The machine is entirely automatic, once it is set The observer sits at the end, and turns a crank. When it will turn no farther the hands point to the day, the month, the hour, the minute, and the height in tenths of a foot of the tide. Pressure of a button in the crank releases it, and the next stop indicates the same data for the next tide. All the time the machine is doing this it is also tracing out the tidal curves, which are filed away for reference, so that should any question arise as to the figures as the operator takes them down, the machine need not be reset to get them over again; reference to the tidal curve will show all that the machine has shown

The machine is two sided; one side has the tidal fluctuations to care for, the other, the time, so that when the prediction is made, it is complete. The copy, as it is made from the machine by the observer, goes directly to the printer, ready to be set up and printed.

Mr. Fischer strove long for some scheme by which a mechanical means of summation could be obtained which would eliminate a chain. Always he came back to it as the most practical. Every single thing about this wonderful machine was made by the Instrument Division (castings for the base are excepted) save the chain, which is fine chronometer chain, imported from England. To be sure that it was properly stretched, and worn and smooth in its actions, Mr. Fischer ran it in an endless belt form, over dozens of pulleys of all sizes, on the walls of his workshop, driving it eight hours a day by electric motor for months and months. It was bent in every link, not hundreds, but thousands of times, until, when it was put in the completed machine, it had done all the wearing possible.

As an instance of the extreme accuracy of the machine, Mr. Fischer told the writer of some tests which were made of it.

"We picked out two stations for these tests," said Mr. Fischer, "which we believed would most thoroughly test the machine because of the complicated nature of their tides These stations were Aden, Arabia, and Hong Kong, China For Aden we used thirty-five components of a tide and for Hong Kong thirty-three.

"We started the predictions at the beginning of a year and ran the machine until it had predicted the tides for almost the whole year at both these places. Not until then did we take a reading. Then we read the prediction for a given day. When we compared this reading, which had come after the machine had had a chance to add up infinitesimal errors through a year's predictions, with that of the most careful and accurate human calculation, we found a maximum error of 0.02 of a foot for the Aden tide, and 0.06 of a foot for the Hong Kong tide."

To do the same work in the same time, taking in the same number of factors or components, would require one hundred men. One wonders whether they would be anywhere near so accurate as the great brass brain.

The machine bears upon its face, by order of the Superintendent of the Coast and Geodetic Survey, the legend "Designed and constructed by E. G. Fischer." It is a monument not only to those men who went before—Lord Kelvin and Prof. William Ferral—but to the gentleman whose profound knowledge of mathematics, skillful ability in instrument work, and cleverness as a designer, made possible the greatest and most remarkable calculating engine in the world.

The Quantum Theory of Energy

THE old controversy so beloved of the Greeks as to whether matter is continuous or discontinuous is in our day definitely resolved in favor of the latter view. It is true that the ultimate particles of matter are considered to be something in the nature of local modifications of the ether, but nevertheless, matter as matter has a discrete structure This tendency to atomize has now been imported into the conception of energy. At first sight it would seem that energy is something necessarily continuous, but it is found that this assumption leads us into serious difficulties. It is by examining the phenomena of heat and light radiation from bodies that scientific men have been led to adopt the remarkable hypothesis which postulates an atomic structure for energy.

When, by a process of strict reasoning from certain fundamental and well-established principles we arrive at an expression for the amount of radiant energy emanating from a hot body and existing in a unit volume of the ether, we have two very astonishing results. In the first place, experiment shows that the total amount of energy existing in a unit volume of the ether is distributed among the rays of different wave lengths in such a way as to be a maximum for a certain wave length (depending on the temperature) while our theoretically obtained expression does not admit of a maximum. In the second place, according to our formula the total quantity of energy would be infinite, a result which cannot be admitted. Planck, the great German physicist, was accordingly led to consider a radiating body as made up of a number of small bodies called resonators, the energy of which varies in a discontinuous manner. The total energy possessed by any resonator (which might be an atom of sodium, for example) at any time must be a whole multiple of some fundamental unit of energy. The atom of energy in any case depends upon the frequency of oscillation of the resonator and is, indeed, simply proportional to it. This very strange theory enables a formula to be obtained for the quantity of energy *per unit volume of the* ether due to radiation which agrees with experiment, possesses a maximum, and gives a finite value for the total quantity of energy. It was discussed before a distinguished audience at the last meeting of the British Association and promises to be of great importance in many branches of scientific investigation.

Correspondence

[illegible] editors are not responsible for statements [illegible] in the correspondence column. Anonymous com[illegible] cannot be considered, but the names of [illegible] will be withheld when so desired.]

A Plan for Safeguarding Miners

[illegible] Editor of the Scientific American:

[illegible] the number of lives yearly exacted in coal [illegible] from explosions, black-damp, roof falls, flood- [illegible] passageways in mines, and for which no adequate [illegible] has yet been devised to counteract by allowing [illegible] an opportunity to escape, the problem leads me [illegible] submit for your consideration a plan by which in [illegible] all cases of mine disaster the loss of life could [illegible]. The plan, as any practical man can see, [illegible] entail on mining companies a large additional [illegible], but for humanity's sake mining companies [illegible] been compelled by legislation to adopt equipment [illegible] the safeguarding and welfare of mine workers.

The idea is as follows:

By referring to Fig. 1, the wall of one side of the [illegible] passage should be undercut or sloped as shown in sketch to receive a pipe or tube twenty-four inches in diameter by one quarter of an inch thick, riveted and calked watertight. This emergency tube to extend throughout the main passages of the mine, this tube to have watertight doors placed every hundred feet apart, and where there is a vertical shaft, grab irons or steps be riveted on inside of vertical portion of tube to top of mine shaft.

The operation or use of such a tube would be as follows:

In the event of a "cave-in," or the roof collapsing, cutting miners off from the outside world, and bringing them face to face with death from starvation or thirst, the miners would enter pipe or tube through manhole nearest to them and get through or past the "cave-in" or fall, and return to daylight, home and life without having heart-rending accounts published of men buried alive. In fact, operations could be carried on the same as usual while the "cave-in" was being removed.

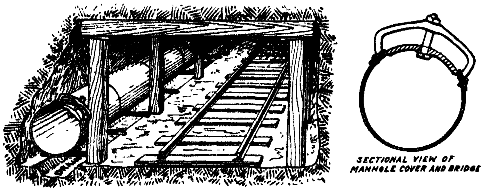
In the event of a mine explosion, provided there was no fire vomiting from mouth of mine, the miner could escape the danger from "black-damp," or the deadly gas which follows a mine explosion. Of course, these manholes and doors should be closed from the inside as soon as the last man has entered. The fan blast system in use in mines could be arranged so as to feed the emergency tube constantly with fresh air. This emergency tube could extend to top of both the down and up shafts, allowing escape from a mine either way.

In the event of a mine getting flooded with this means of escape at hand no lives would be lost, for men with nerve enough to work in a mine, would possess sufficient nerve to take advantage of this means of escape to save their own lives by entering the tube which would lead them to the world above, their families and complete safety.

I hope for humanity's sake this idea will be made use of. I do not know of any channel more suited to exploit this suggestion than the columns of the Scientific American, which reaches men engaged in the great work of making our industries safer and more attractive to the worker.

The initial cost of such an emergency tube should not be any more prohibitive than the cost of hoisting engines, pumps, fans, or any other kind of equipment necessary for the mining of coal. I feel assured that such an appliance would decrease by a large percentage the number of lives annually lost and chronicled as imprisoned, overcome by black-damp, or drowned by not having a means of escape.

Detroit, Mich. George W. Bowie.



An emergency tube for miners.

Philippine Industries

To the Editor of the Scientific American:

Our attention has been invited to certain articles appearing in the Scientific American from time to time concerning the industrial situation in the Philippine Islands. Particular reference is made to an article appearing recently in which the extension of hat making in the Philippine Islands was discussed. We believe it well to bring to your attention some first hand information on what is being done along industrial lines in the Philippine Islands, and to refer you to certain publications of the Bureau of Education on industrial subjects.

The Bureau of Education maintains a very complete system of industrial instruction in the Philippine public schools. Special attention has for some time been given to basketry, loom weaving, lace making and embroidery, wood working, iron working, and domestic science and sanitation. The industrial system has gradually been extended until at present 98 per cent of the pupils in the Philippine public schools receive some form of industrial training. Most of those not receiving industrial instruction are in the secondary grades.

The Bureau of Education has published for nearly two years an industrial magazine under the title, *The Philippine Craftsman*. This magazine was founded for the purpose of encouraging industrial instruction and making available to all interested parties the results of the industrial work in different sections of the islands and the plans for further extension of industrial instruction into the public schools. It encourages the development of native arts and the introduction of such as will prove of economic value to the people.

Manila, P. I. C. H. Mayer, *Acting Director.*

That Coin Problem

To the Editor of the Scientific American:

The following is my answer to the United States coin problem, published in the Scientific American of February 7th:

100	1-cent	$1.00
9	5-cent	.45
13	10-cent	1.30
13	25-cent	3.25
13	50-cent	6.50
13	2.50 gold	32 50
13	5.00 gold	65.00
13	10.00 gold	130.00
13	20.00 gold	260 00
200 coins.		$500.00

Theodore L. DeLand, *Shipping Clerk.*
United States Mint, Philadelphia, Pa.

To the Editor of the Scientific American:

In your issue of February 7th, on page 117, under the heading "A Problem in United States Coins," the question is asked, "How can 200 coins of the United States (present coinage) be so divided as to total $500? Every coin to be used at least once." Here is one answer:

60	.01	$0 60
6	.05	.30
6	.10	.60
6	.25	1.50
14	.50	7.00
68	2.50	170 00
28	5.00	140.00
6	10.00	60 00
6	20.00	120 00
200		$500 00

Possibly there are other combinations, or perhaps the question is not complete. F. M. Greene.

Minneapolis, Minn.

[We can publish no more letters on this subject.—Editor.]

A Miniature Volcano

To the Editor of the Scientific American:

Recently I saw a very interesting imitation of a volcano, and as it may be of interest to your readers, I shall describe it.

A slag pot, containing about four tons of slag from a lead blast furnace, had been set on the dump to settle before being tapped. The top was covered with a crust of slag which would take a good blow with a sledge to break. In one place near the center was a hole where the slag was still red hot and molten. Every little while flames came up from this and some gas was given off, throwing the slag up around the edges till a mound was formed around the hole. Every minute or so a flame and some smoke shot up and some slag overflowed the top and ran down the sides till it cooled, thus building the mound higher. These eruptions continued about one or two minutes apart till the mound was about six inches high. Every one consisted of flame, smoke, a flow of lava, and then a period of quiet. This continued till the pot was tapped, perhaps twenty minutes, when the withdrawal of the slag stopped the eruptions.

A mixture of adobe and water had been put in the pot before the slag had been tapped into it, to allow the shell to come out easily, and probably a reaction between this and the hot slag caused the phenomena.

The tapper at the dump informed me that he had seen a number of these little volcanoes, but they were by no means common. Edward P. Chapman.

Pueblo, Colo.

The First to Signal Through Space

To the Editor of the Scientific American:

In a notice of John Walker Wilkins, in Scientific American of January 31st, it is stated that he was "the first man in the world to transmit telegraphic signals through space." From data in the notice, it was not earlier than 1845 or 1846 that he did this, three or four years subsequent to the time that Joseph Henry, American physicist, had "traced the influence of induction to surprising distances, magnetizing needles in the lower story of a house through several intervening floors by means of electrical discharges in the upper story, and also by the secondary current in a wire 220 feet distant from the wire of the primary current." (Enc. Brit., 9th ed., vol. xi, page 675.) In connection with these experiments he discovered the oscillatory nature of the electric discharge. I know of no earlier signaling through space by the use of electric currents.

Carlisle, Pa. I. Thornton Osmond

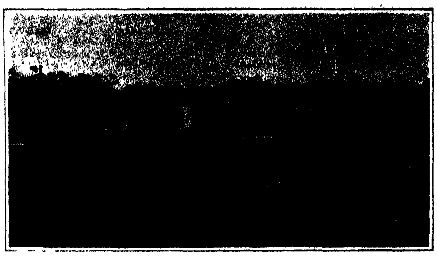
The "Nevada" and "Queen Elizabeth" Compared

To the Editor of the Scientific American:

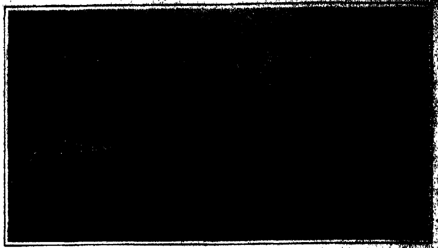
I noticed in one of your recent publications remarks by Mr. C. P. Slosson, San Francisco: the comparison of the British "Queen Elizabeth" and United States 'Nevada;" also remarks on speed of British battle-cruisers. I also noticed your answers to said remarks. Now if you will permit me, I would like to say a few words. In the first place, I may say it has always been a very great pleasure to me to read your valued paper. A Britisher naturally likes fair play, and I am sure the Scientific American puts a thing fairly and squarely before the public. Of course, in making a comparison it is only fair to compare contemporary ships. Now, take into consideration the four great events or essentials in a warship, viz., speed, radius of action, gun power, and defensive armor. Of course, the British ship has the advantage, a great advantage, in speed. In radius of action, as both ships are to use oil fuel exclusively, and as reliable data are not at hand, I cannot say for sure as to which has the advantage on that point. In gun power we have ten 14-inch guns with 1,400-pound shell, and 2,600 foot-seconds, energy, 65,008 foot-tons on the "Nevada." Eight 15-inch guns with 1,950-pound shell, 2,500 foot-seconds; energy, 84,510 foot tons on the "Queen Elizabeth." Here we see the British ship, although carrying fewer guns, throws a heavier weight of metal at a discharge with a greater energy, which would be more effective at long range. The weight of the American gun is 63 1 tons. The weight of the British gun is 96 tons; both 45 calibers long. In defensive armor or qualities of defense the principal interest in the "Nevada" class is their great defensive power and the armor has been, or will be, so disposed to a greater advantage than on any ship hitherto built, at least from the American standpoint. From a British standpoint the armor is so disposed on the "Queen Elizabeth" to the greatest possible advantage; the armor on both is about the same maximum thickness, so in recapitulation we have "Queen Elizabeth," greater speed; "Queen Elizabeth," greater gun power, 'Queen Elizabeth," at least equal defensive power, "Queen Elizabeth," questionable radius of action. You cannot put a quart of power in a pint of displacement, and as both displacements are about the same, for the displacement given of British ships are their displacements when in commission with full load of stores, ammunition, etc., but with normal coal capacity, I take it that British designers have turned out the better ship, more especially as the cost per ton is less in the case of British ships. Take for instance contemporary ships "Neptune" and "Delaware." The British "Neptune" works out $418 per ton. The United States "Delaware" works out about $450 per ton. The British ship "Lion" worked out at $382 per ton. W. R. Shute.

Woodstock, Ontario.

Roadside Signs, each containing a single catchy sentence in large type, are proving effective in warning against fires on western forests. They give the essentials and tell the importance of protection against forest fires.



Gaging station at Gatun spillway. Measuring the flow (18,000 cubic feet per second) from a suspended car.



First water discharging through the Gatun spillway after the lake has been filled to the full 85-foot level.

Navigating Lights for the Panama Canal

How Ships Will be Guided Through the Canal by Night

THE lighting equipment of the Panama Canal has been planned with the same care and skill that has been displayed in the other parts of this monumental work. Through Gatun Lake and at the approaches the sides of the channel will be marked by gas buoys, and except in Culebra Cut, a set of flashing range lights will be placed at each end of the successive tangents. The sailing lines, as indicated by the range lights, will be sufficiently wide apart to enable the largest vessels to pass one another in safety.

In Culebra Cut, the banks are so close together as to make the use of range lights impracticable. In this part of the canal, three lighted beacons will be placed at each angle or turning point in the cut and between these there will be intermediate lights in pairs on each side of the canal. While these lights are deemed ample for safe navigation, it will not enable travelers to see very much of that famous locality should their ship pass through on a dark night. All the beacon and range light towers along the canal will be of molded concrete.

The locks, however, will be brilliantly illuminated by electricity. On the walls of the locks there are molded concrete lamp standards, carrying hoods of concrete in which are mounted large, 400-watt, tungsten bulbs. The hoods will be so arranged as to throw the light on the coping of the lock, and the water chamber, but will screen the lights from the axis of the canal. If these brilliant lights were not shaded, the pilots on approaching vessels would be so blinded as to hinder them from observing the range and signal lights. Excepting the locks, acetylene will be used exclusively for lighting the canal both in the towers and on the buoys. These lights will be automatic in the sense that they will require absolutely no attention for a period of from four to seven months after they have been once started. At the end of that time their supply of acetylene is replenished and they are good for another period. This system, known as the A. G. A. (American Gas Accumulator Company) system, was first introduced in this country in 1908, and since then has been installed in over three hundred important light stations on our coast.

This system has perhaps its highest development in the gas buoy. The lighted buoy is considered one of the most important and reliable aids to navigation invented in recent years. The lights of those installed by the lighthouse authorities on various stations on the coast, are plainly visible from six to fifteen miles and will burn for long periods up to a year or more without any attention. The buoys along the canal will be equipped with sixth order lights, and the gas supply in each beacon is designed to last from three to seven months, the time depending upon the characteristic of the light. These buoys will be of the same standard type used generally by the lighthouse service. Its structure is indicated in Fig. 1, and it consists of a cylindrical floating steel body carrying on its top a pyramidal steel frame which supports a light and lens fifteen feet above the water level. To the bottom of the body is attached a steel tube carrying a counterweight, and this tube is made detachable from the buoy body to facilitate transportation. The buoy will be moored on its station by heavy chain and concrete sinkers. The corrosive effect of the waters of Gatun Lake, due to decaying vegetable matter, is very pronounced, and hence the metal surfaces will be given a special protective coating.

The body is eight feet in diameter and has dished heads, and in the periphery of the upper one are four pockets for the reception of the cylinders containing acetylene, technically known as "accumulators." The gas from the four accumulators passes out through a collecting manifold and thence up a feed pipe secured to one of the upright frame pieces to the lantern.

The acetylene in the accumulators is stored according to the process invented jointly by three Frenchmen, Claude, Hess and Fouche. This gas, at ordinary atmospheric temperature, is very unstable under a pressure of more than two atmospheres, as it readily breaks down into carbon and free hydrogen under slight shocks, and this is usually accompanied by a violent explosion. When stored by the process mentioned, it is practically safe and harmless. The cylinders are first filled with an inert porous mass having a porosity of eighty per cent, and half the porous space is then filled with acetone a hydrocarbon liquid which boils at 56 deg. Cent. The acetylene is then forced into the cylinders under heavy pressure. The acetone readily absorbs acetylene at atmospheric pressure and under a pressure of 150 pounds it will absorb over one hundred times its volume. The liquid acetone expands in absorbing acetylene and shrinks again to its original volume when the gas is exhausted. The purpose of the porous filler is to prevent the accumulation of compressed gas in the upper part of the accumulator when it is nearing exhaustion. A full description of this method of storing acetylene will be found in the SCIENTIFIC AMERICAN for May 6th, 1911, page 453. A gas plant will be established at Balboa, where the accumulators will be recharged when exhausted, and the acetone which may be carried out with the acetylene will be replaced.

All the canal buoys will have flashing lights possessing several interesting and novel features. The mechanism, as will be seen from Fig. 2, consists of three parts: the pressure reducer or governor, the flasher and the burner. The high-pressure gas from the accumulators goes first to the governor which operates to feed the gas at a constand low-pressure to the flasher. Two sections of the simplest form of flasher are shown in Figs. 3 and 4. It is the invention of Gustaf Dalen, a Swedish engineer. This consists of a heavy cup-shaped casing closed at the top by a leather diaphragm. In the side wall is a gas inlet for the low-pressure gas from the governor and a gas outlet leading to the burner. The inlet is always open, but the outlet to the burner is controlled by a pivoted valve which opens at stated periods, to permit gas to escape to the burner to produce the flash. In order that the valve may move at high speed, the valve seat around the outlet is made one pole of a permanent magnet, and the valve plate is acted upon by a spring to hold it in closed position. The valve plate is connected by an adjustable loose motion device with the diaphragm. When the valve is closed, gas accumulates in the casing under the diaphragm until its pressure is sufficient to overcome the force of the spring and the magnetic attraction of the valve seat. Then the valve opens with a jump and the gas escapes to the burner where it is ignited by a constant burning pilot flame fed directly from the governor. The escape of gas permits the diaphragm to fall and the valve closes quickly. By this mechanism, the pressure of the gas at the burner is constant throughout the duration of the flash, which is a very important feature, as it enables a pilot to judge accurately the characteristics of the light. It is also economical, as it has been found that 55,000 separate and distinct flashes can be obtained from one cubic foot of acetylene. They may be adjusted to give light periods as small as one tenth of a second, but on the canal the minimum period will be three tenths of a second. To give the various lights individual characteristics, a more complex form of this flasher will be used which will produce successive flashes, followed by dark intervals. Although this apparatus is very delicate and capable of fine adjustment, still the parts are so well protected that the buoys can withstand the buffeting of the heaviest seas without derangement.

By an ingenious arrangement of glass prisms on the inside of the vertical bars of the lantern, the light will be so reflected as to prevent the bars from casting any shadow. This is important; for in the older types much of the light is obstructed by the bars and lost. Acetylene light, which is almost pure white like sunlight, has a great penetrating power in thick weather, and as it burns with a small and intensely bright flame, it is easily adjusted in the focus of the lens which facilitates a uniform spread of the light in all directions in a horizontal plane. The hood shown is of sheet copper and serves for ventilation and is so constructed as to make it impossible for wind or sea to extinguish the light.

This type of buoy has been placed on each lan-

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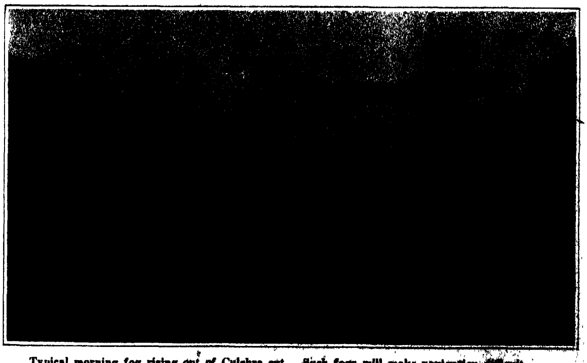
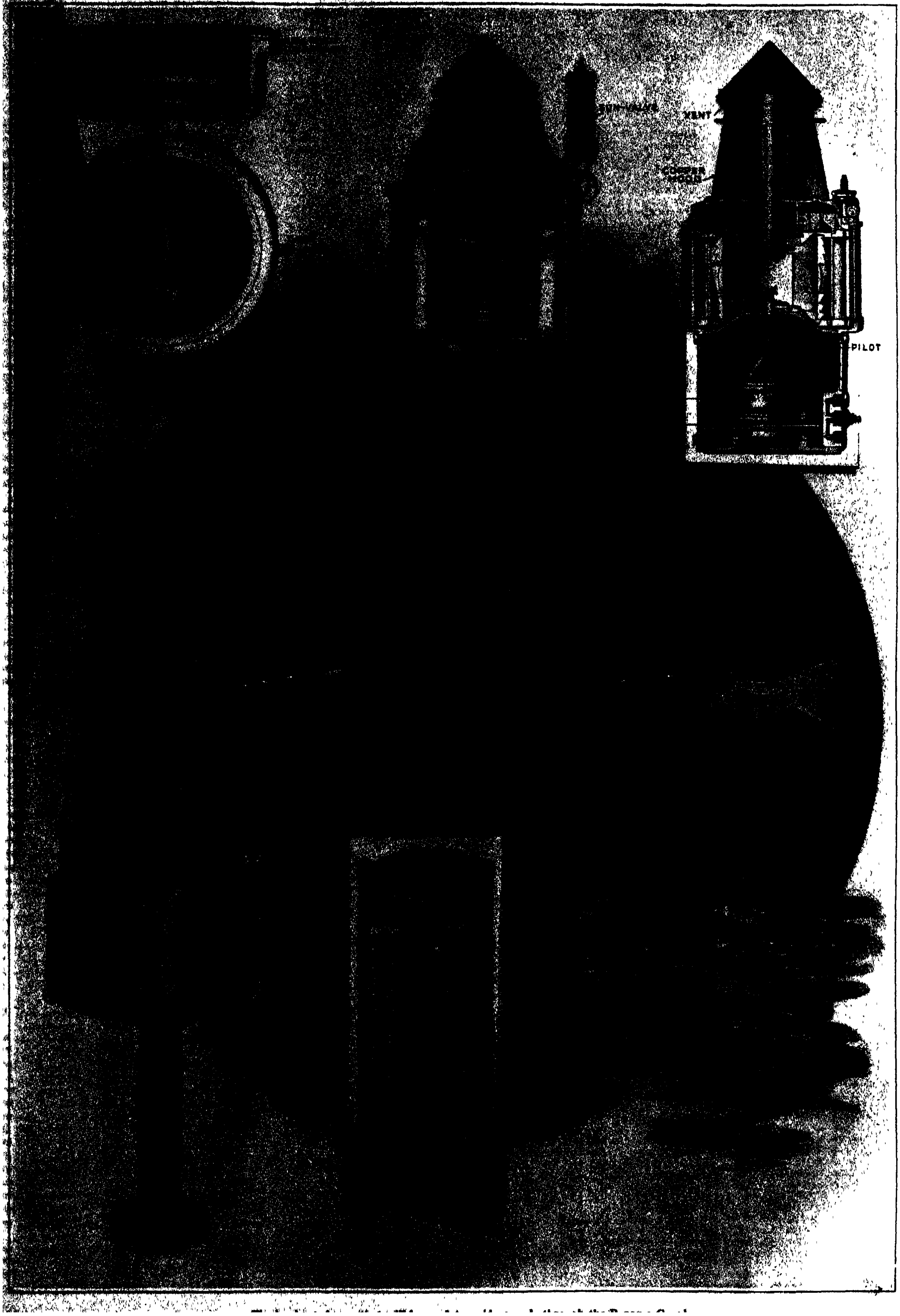


Typical morning fog rising out of Culebra cut. Such fogs will make navigation difficult.


VENT
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The Problem of Our Navy

II.—Sea Power and Our Foreign Policies

By the Editor

WE have it on the authority of the greatest of all books of wisdom that "No man liveth to himself"; and what is true of the individual may be applied with ten-fold emphasis to the nation. Although ambition is one of the most compelling forces in the make-up of the average individual, there has always been a minority of men who would gladly forego the larger prizes if they might only pursue their plan of action well out on the edge of the maelstrom of life, and as far removed as possible from the hazards of its central vortex. Hence, the hermit of early times and the shy recluse of our own day.

History can afford instances, not a few, of states and nations which have exhibited, from the very day of their birth, a decided spirit of reserve, a wish, sincere, well reasoned out, and formulated as a definite principle of action, to work out their destiny in an attitude of international aloofness, even if it involved isolation.

To find a conspicuous example of this spirit it is not necessary to go beyond our own borders. When our fathers "brought forth a new nation, conceived in liberty and dedicated to the proposition that all men are free and equal," they warned this country against any "entangling alliances" with foreign powers. The young Republic, guarded and guided by a Constitution into which its noblest men had written its highest ideals, set itself to the task of realizing those ideals in the unhindered development of the country, vast in extent and rich in its natural resources, of which, by the sword, it had recently won acknowledged possession.

Set midway between the Occident and the Orient, separated by a barrier of three thousand miles of ocean from the one, and by five thousand miles of the little-known Pacific from the other, the new-born State believed that its problems lay, and would forever lie, strictly within its own borders, and that its national policies would always be purely domestic in character—that they would never broaden out into policies of an international scope.

And so, for a full century of its existence, the United States worked out its destiny along and within the lines laid down by its founders. In numbers, wealth, industry and commerce it grew amazingly, and if war came, it was a war of defense. The one definite policy that was pregnant with possibilities of European complications, the Monroe Doctrine, was adopted early in our history at the suggestion of Great Britain, whose fleet stood ready in those early years to enforce the doctrine should it be challenged. It is only in late years that the Monroe Doctrine has loomed up in all its portentous significance.

Hence, throughout the first century of our national existence, the armed forces of the country, both naval and military, were regarded and designed purely for purposes of defense; and it is significant of this spirit and of the purely national as distinguished from the international character of our policies, that our first three battleships, the "Oregon," "Massachusetts" and "Indiana" were officially designated as coast-defense battleships—they were not designed, nor were they qualified, for service in far-distant waters.

Then, in the midst of our self-engrossed and aloof national life, came the roar of the "Maine" explosion; and before our President could exhaust the last resources of diplomacy, the United States was at the death-grip with a European nation! The century-long day of our isolation was over. From that war we emerged a great world power, to find ourselves standing toe-to-toe with the naval and military giants, young and old, of Asia and Europe.

How many of the eighty millions of us, in 1898, realized that in reaching out a pacifying hand across the few miles of water dividing Key West from Cuba, we were commencing to move our frontiers out into the international ocean highways of the world, and that when, at the close of the war, the extension had ceased, those frontiers would have been pushed nigh a thousand miles eastward into the Atlantic, and westward some five thousand miles, even to the very doors of Asia.

Not for a moment did the nation regard the Spanish war as one of aggression; it was supposed to have been fought in the interests of humanity, and for the abatement of the horrors of the Cuban situation. If we remember rightly, the diplomatic intercourse, antecedent to the war, deplored the disturbing conditions "*on*" or "*near our borders.*" It was the propinquity of the trouble that brought it within our concern—had Cuba been off the coast of Spain, the rebellion might have been raging yet, so far as any protest from this country would have been concerned. But, in fact, though not with definite intent, this nation, in declaring war against Spain, abandoned a policy of isolation for one of commanding importance in the great-world politics!

It is for us, now, either to play the games with great-world weapons and on a great-world scale, or confess ourselves unequal to the task, let go what destiny thrust upon us and be subjected by the leading powers to that attitude of interested tolerance which obtained before the war took place. There is no middle course. In the Atlantic the struggle left us in possession of Porto Rico, with oversight of Cuba and the possession of Guantanamo Bay, one of the finest strategical bases in the West Indies. In the Pacific we emerged with full responsibility for the Philippine Islands and holding also Guam, a most valuable strategic base in the Mid-Pacific. Verily, we have given hostages to fortune.

It is extremely significant that the subsequent course of our foreign policies, so far from showing any disposition on the part of the Administration to deplore the conditions which had established us in a very strong strategic position in both the Atlantic and Pacific Oceans, has rather indicated that we were disposed to utilize that position to the fullest advantage. Stimulated by the successes of the Spanish war, we built up our navy, and particularly its first fighting line of battleships, so assiduously that within a single decade we had risen to the second place in naval strength. Vith a natural naval base at Guantanamo, giving us a commanding position in the Caribbean, we took in hand the [illegible] possible task of cutting a canal from the [illegible] Pacific at Panama. For certain [illegible] the treaty rights of Great Britain at Panama, [illegible] the neutrality of the canal, and prepared to [illegible] that neutrality by erecting first-class [illegible] each approach. Not content with this, we proceeded to reaffirm the Monroe Doctrine by definite Congressional action, forbidding the acquisition by alien powers of harbors or coaling stations which were located within striking distance of the Panama Canal and which might serve as a base for hostile operations.

It is well understood that commercial rivalry is becoming more and more the predisposing cause of modern wars. Our opening of the Panama Canal will cause an upheaval in existing trade conditions and a quickening of commercial rivalries the like of which the world has never seen. Furthermore, its effect upon the balance of naval power, particularly in the Pacific, and in any conflict which may arise over the enforcement of the Monroe Doctrine, will be most profound. What Gibraltar and the Mediterranean were to the contending navies of the eighteenth century, the Panama Canal and the Caribbean will be in the future naval [illegible] of the New World.

And across this key to the commercial supremacy and the naval dominance of the Western Atlantic and the Pacific the United States stands, a colossus dominant and uncompromising.

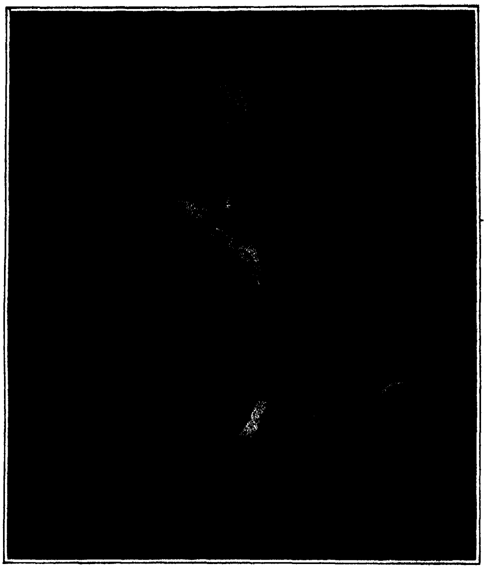
If we were slow in taking up our position as a world power, history will never charge that the United States was slow to assert the prerogatives of a world power. Not content with our reaffirmation of the Monroe Doctrine, which doctrine a recent friendly British critic has described as "the most magnificent bluff in all history; and, so far, the most successful," we have taken the vast problem of China into our benevolent keeping and have spoken out boldly for the "Open Door of Trade" as against Europe's pet theory of separate spheres of influence, thereby setting our face firmly against any attempt to destroy the integrity of that greatly coveted country. Lastly, we have looked squarely in the eye the most intelligent, refined, proud and successful of the Oriental races, and told it that we do not want and will not have its members in our midst. And this we have done to a people who, by defeating on land and sea the supposedly most powerful nation in the world, had but recently graduated, by universal consent, to the rank of a first-class naval and military power.

Such are the international policies of the United States in this year of our Lord 1914.

Discoursing on the subject of the policies of nations, a recent naval authority has this to say: "Modern science has made the nations of the earth neighbors, and modern thought has tempered the intercourse of many races, but national ambitions take life and grow as the nations prosper and, being like those of the individual, essentially selfish, the ambitions of one nation often excite the rivalry and opposition of another. So are born the policies of various peoples. When declared, these policies are but the formulated principles of conduct which the people of a State, or their Government, have adopted in the pursuit of their national well being. *When the policies of a State reach beyond its borders, they become of special interest to other States, for, as has been intimated, in these policies may be found the seeds of disagreement, perhaps of ultimate war.*"

Of such a character are our international policies. They are broad enough to bring us into most intimate contact with the policies of the other great powers of the world, and they are, therefore, big with possibilities of acute disagreement and ultimate war.

When a nation thus formulates its policies, it should



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Josephus Daniels, Secretary of the Navy.

Whether or not we shall have a first-class navy to enforce our policies depends in part on him.

[illegible] both the manner of their presentation to [illegible] nations whose interests may be affected and the subsequent attitude in case these policies should be [illegible]. It may offer them as a request, to be [illegible] or refused or ignored as the case may be, or it may boldly proclaim them as being so necessary to the national well-being and honor that they will be supported, if occasion should require, by all the armed forces of the State.

Now it is evident that to present such ambitious international policies as have been adopted by the United States in the form of a request would be as futile as it would be ridiculous—their very magnitude and daring [illegible] world at large as an intimation that we are prepared to defend them with all the available forces [illegible].

And this brings us face to face with the question: [illegible] power are we likely to possess in the near future, [illegible] power to resist such armed opposition, and by crushing opposition, enforce the consideration of our policies upon any future enemy or coalition of enemies? To this the answer must be made that, because of the geographical situation, a war for the maintenance of our policies must of necessity be a naval war, and that the navy of the United States is utterly inadequate to the magnitude of the task. The struggle for the enforcement of the Monroe Doctrine, the neutrality of the Panama Canal, Asiatic Exclusion, or the Integrity of China, will take place upon the high seas, and the situation is such that in the event of war to-day or to-morrow, we would find ourselves in the precarious position of having to defend first-class policies with a third-class navy.

We do not hesitate to say that the work of bringing the American navy up to the Standard of Strength called for by our national policies is by far the most pressing question now before the American people, its Congress, and its President.

It may be said of the people of the United States, as a whole, and to a great extent, of Congress itself, that they are so deeply engrossed with internal economic questions that they follow with a languid interest the course of international politics. It is only to a few in our Foreign Affairs Committees and in our diplomatic and naval and military services, that the portentous significance of the events which have led us to the present conditions have been known, and by them only has the alternative of either a disgraceful abandonment of our policies or a humiliating defeat in their attempted defense by inadequate naval and military forces been foreseen.

Universal arbitration, to which we all look forward with eager eyes, would present a way of escape from the existing dilemma, but the comparatively meager results of such Hague meetings as have been held, due to keen international distrust, has shown that this remedy is as yet in the far future.

And since arbitration is for the present at least but a beautiful dream, it behooves this nation to take careful count of things as they are and make at once a drastic readjustment between our policies and our sea power. We must modify our policies by retrenchment, or we must at once take all needful steps to bring the navy up to the full measure of its heavy responsibilities.

The nation is confronted with two alternatives, and two only. Either we must give up Guantanamo, Porto Rico, Hawaii, Guam and the Philippines; leave China to the rapacity of the Great Powers; dismantle our forts at Panama, placing the canal under joint international control, rename our first fighting line "coast-line battleships," and withdraw entirely within our own frontiers, or we must accept the burdens of a great world power, not with hesitation, but rather with a glad courage, remembering that these burdens are not of our own seeking, but have been laid upon us by a destiny against which there is no appeal!

The Scientific American and the Libraries

WE gather from a recent issue of the Boston *Transcript* that the SCIENTIFIC AMERICAN has been critically compared with every important periodical published in this country, with the result that it stands in a very special class of magazines favored by Massachusetts librarians. A committee was appointed at the fall meeting of the Massachusetts Library Club, which unanimously reported the following resolution:

> The members of the Massachusetts Library Club view with strong disapproval the alarming decadence in tone of many of the leading American periodicals, and emphatically protest against the tendency recently so manifest to cater to sordid sensationalism, indecent suggestion and to perverted taste.
>
> The committee has had several meetings, at which have been discussed the merits and demerits of certain leading periodicals, and it has prepared a list of fifty magazines which are recommended for small libraries, arranged in groups of ten, to cover the demands of libraries subscribing to ten, twenty, thirty, forty or fifty periodicals. This list it is proposed to print in the next issue of the Massachusetts Library Club Bulletin, and the committee also suggests that the State Library Commission publish it for distribution among the smaller libraries of the State. It is not to be understood that all of the reputable journals are included. The list is limited by the number chosen, and by the plan by which the committee endeavors to put in each group of ten magazines which should appeal to the various classes of a community. A list has also been made of twenty magazines, covering special subjects of a more or less technical nature. One or more of this special list could be inserted in the place of one in each group of ten, according to the demands of each locality.

In the first group, which comprises those periodicals which are indispensable to every library, however small, we find mentioned in company with the SCIENTIFIC AMERICAN, the following magazines: *Atlantic Monthly*, *Harper's Magazine*, *National Geographic Magazine*, *Outing*, *Outlook*, *Popular Mechanics*, *St. Nicholas*, the *Survey*, and the *Woman's Home Companion*. In group IV, which comprises magazines that are recommended to libraries which are able to pay for at least forty periodicals, the SCIENTIFIC AMERICAN SUPPLEMENT is recommended in addition to the *American City*, the *American Magazine*, *Bulletin of the Pan-American Union Republics*, the *Craftsman*, the *Dial*, the *Etude*, the *Illustrated London News*, *Popular Science Monthly* and *System*.

In Group III, which comprises magazines intended to cover the demands of libraries subscribing for thirty periodicals, we find mentioned in addition to *American Homes and Gardens*, which is published by Messrs. Munn & Co., Inc., publishers of the SCIENTIFIC AMERICAN, the *Boston Cooking School Magazine*, *Current Opinion*, the *International Studio*, *Modern Priscilla*, the *North American Review*, the *Review of Reviews*, *School Arts Magazine*, *Scribner's Magazine*, and the *Technical World*.

This analysis of current American periodicals is interesting and important because it shows how the Massachusetts Library Clubs Committee rates magazines in closely allied fields. *Popular Mechanics* and the SCIENTIFIC AMERICAN are evidently not regarded as covering the same field, for both are included in the indispensable magazines which even the library capable of subscribing for only ten periodicals should keep on hand.

All the publications of Munn & Co. find a place in one of the groups. The publications of the Century Company (the *Century Magazine* and the *St. Nicholas Magazine*), and Messrs. Harper Brothers, who publish *Harper's Magazine* and the *North American Review*, are the only other publishers of periodicals similarly honored.

Despite the flood of home and garden magazines which have made their appearance within the last ten years, only one other periodical of that type besides the *American Homes and Gardens* is mentioned in the groups, and that is the *Garden Magazine* of Messrs. Doubleday, Page & Co., which is included in Group II. *Country Life in America* is placed in a special list of twenty magazines "covering special subjects of a more or less technical nature."

Commenting upon the analysis the Boston *Transcript* states:

> "The report, and the accompanying lists, have allowed some librarians, inferentially and diplomatically, to ease their minds on the subject of some of the putrescent fiction which appears in a few magazines. This is a good thing.
>
> "It would be hard to estimate the exact amount of moral harm worked by this near-indecency in periodicals. Probably it is very small. The worst thing about it is the sickening insincerity of it all, and its result upon literary freedom After a few years in which a diluted form of sewage is offered under the name of 'red blood,' and slightly smutty stories are sold under the plea that art, truth, and frankness are in peril unless such stories are allowed, then there is apt to be a reaction in favor of prudishness. The news agent who whispers to you that he has got 'something shady' which he would like you to buy, may not be an admirable person, but he is worthy of rather more respect than the magazine editor who offers the same thing with a hypocritical plea that this is 'artistic truth.'"

Skating on Salt

By Walther Isendahl

NATURE has been conquered once more. Men can skate, not on ice, but on salt. A salt-skating rink, constructed by the patented process of Dr. Ed. Arnold, was recently exhibited and operated in Berlin

All skaters will welcome the invention of a method of producing, by purely chemical means and without the employment of a costly refrigerating process, a saline crystalline mass which exhibits all the characteristic properties of ice. The surface of the mass can scarcely be distinguished from a surface of natural or artificial ice, and the resemblance is increased by the fact that the shavings produced by the skates have all the appearance of snow. The mass is entirely odorless and contains no ingredient injurious to the health or the clothing of the skaters. It can be utilized for skating, with ordinary ice-skates, in every season and climate, except when the temperature is higher than 86 deg. Fahr.

The mass can be applied to any tight floor of wood, cement or asphalt, from which it can easily be removed by chipping or steaming. It is preferable to construct the skating floor in a building, but it may be installed in the open air, if it is protected from rain, drying winds, summer heat and direct sunshine by a shed, tent or other covering.

Boards can be coated with the mass and can be quickly assembled to form floors of any desired size, which can be taken apart as quickly. In this way temporary skating floors can readily be introduced on the stage and in public or private festivals, indoors or in the open air Slides for coasting can be constructed by a similar method.

The costs of construction and maintenance of a salt-skating rink are moderate The construction is very simple. The mass is melted and poured on the floor, where it quickly solidifies and forms a hard, smooth surface. It is applied in successive layers, each less than 1/25 inch thick. The cost of upkeep is small, for the "wear" is less than that of ice, especially at low temperatures, and the abraded "snow" is collected, melted with fresh material and used again The mass taken from old skating boards or rinks can be utilized in the same manner The quantity required for a single layer is less than 1/5 pound per square foot A fresh layer must be applied from time to time, with a freqency proportional to the use of the rink Two applications per week usually suffice. A surface of 5,000 square feet can be kept in condition by three hours' daily work of one attendant, in addition to occasional sweeping.

During an exhibition which was recently held in the exhibition building of the Berlin "Zoo" a demountable skating surface composed of wooden planks was used very largely and its durability was thoroughly demonstrated.

The Passing of the Sturgeon

IN his last annual report the United States Commissioner of Fisheries says that "the story of the sturgeons is one of the most distressing in the whole history of the American fisheries." For years these large, inoffensive fishes were supposed to be of no value, and when, as often happened, they became entangled in fishermen's nets, they were knocked in the head and thrown back into the water. When it was discovered that the sturgeon's eggs were valuable as caviar and its flesh as food a period of reckless fishing began, and in a few years the best and most productive waters were depleted, and what should have been made a permanent fishery of great profit was destroyed On the Atlantic coast the catch of sturgeon fell from 7,000,000 pounds to less than 1,000,000 in fifteen years, and an even more rapid decline occurred on the Pacific coast and the Great Lakes At present the total annual yield for the whole country is less than 1,000,000 pounds, and is decreasing. Meanwhile the demand for the eggs and flesh has steadily increased, with the natural result on prices. A mature female sturgeon now often brings more than $150. The worst of the situation is the fact that all attempts at artificial propagation have failed; so that, unless prompt steps are taken to protect the sturgeon by law, this fish will be practically extinct in American waters in a very few years. The Commissioner recommends that the legislatures of all States in which this fish exists or has existed should absolutely prohibit its capture or sale for a period of at least ten years. Meanwhile the Bureau of Fisheries proposes to transplant into our waters young sturgeon from foreign countries; especially a species from the Danube and the Caspian Sea, specimens of which have been offered by the Roumanian government.

Sikorsky's New Record

A DISPATCH appears in the New York *Times* of February 27th to the effect that on February 26th last the Russian engineer Sikorsky's biplane carried seventeen persons in a flight of 18 minutes' duration.

This is the second machine that Sikorsky has built Like its predecessor, it is huge, indeed by far the biggest flying machine ever constructed. No absolutely trustworthy dimensions have yet been published, nor have any really trustworthy details of the construction been given out. It seems certain, however, that the machine has a span of at least 80 feet, and that it is driven by four motors of 100 horse power each The passengers take up their places in an inclosed cabin of such size that seating and even sleeping accommodations are provided for some of them.

Wireless Weather Reports in the Indian Seas

WITH the rapid increase in the number and efficiency of the wireless telegraph stations on the coasts of India, it has now become practicable to issue daily weather bulletins by wireless to vessels over most of the Bay of Bengal and the northeastern part of the Arabian Sea. Six coast stations are open day and night, and any vessel-master can obtain the weather bulletin from the nearest of them on application The importance of the new service is due to the fact that both of the seas in question are notorious for their cyclones. These are most frequent in spring and autumn, but are likely to occur at almost any time.

At Work on the Lincoln Highway

THE accompanying photograph is a 5-ton motor truck at work on the Pennsylvania State Highway. Construction is under way from Philadelphia to Pittsburgh, and when completed this road will be part of the coast to coast Lincoln Highway. Four and five trips constitute a day's work, a round trip averaging ten and one half miles. Loading time is about twenty minutes, as it is done by a gang of four men with hand shovels. The grades on this particular stretch of road are all the way from eight per cent to twenty-five per cent.

Novel Method of Ice Sawing

IMPROVED methods of sawing ice are receiving increased attention to-day on account of the high cost of labor and large number of men needed to harvest a cut. A recent development in this field is shown in the accompanying photograph, which illustrates the application of the electric drive to multiple sawing in a channel located just outside the ice house. Instead of cutting the ice into small blocks on the lake surface and then poling it to the house at the risk of re-freezing, the ice is now cut on the pond into cakes 12 feet long and 18 feet wide, after which the cakes are put through the saws longitudinally and transversely, and are thus cut into 63 blocks per cake and fed into the house at the rate of about 5,000 tons per day of 10 hours. The saws are 36 inches in diameter and are run by electric motors mounted on a temporary platform at one side of the channel. A saving of about $100 a day is effected as compared with the old method of sawing on all parts of the lake, the reduction in labor and teams required being a striking feature.

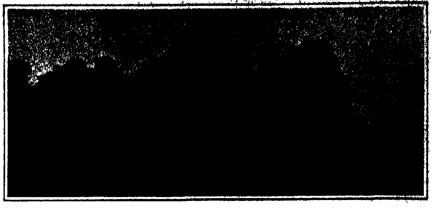
Electrically-controlled Shutter for Automobile Headlights

TO meet the conflicting demands of motor car drivers and city authorities, the headlight shown herewith has been designed. It consists of two pairs of translucent wings mounted on pivots or bearings fastened in the headlight reflector. These wings are made to open and close by electro magnets situated inside the cover of the lamp itself. When running in the city, where it is necessary to use reduced light in the headlights and avoid glare, the wings are closed simply by pressing a push button conveniently situated on the dash. When the wings are closed, there is absolutely no glare, but the road near the car is flooded with strong, diffused light, a fact which makes the lamp particularly valuable when rounding sharp curves. At any moment when it is desired to use the full illumination of the lamp, it is only necessary to push another button which opens the wings, and the concentrated search light beam is at once available.

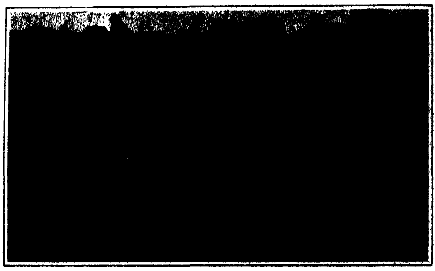
When in the folded or open position, the wings do not perceptibly affect the light given off by the lamps, as they are very thin and are so placed that they do not perceptibly obstruct the rays of the headlights when folded. The electro magnetic control is extremely convenient, and it takes only a small current from the battery just at the moment when the wings are either opening or closing. The power required for operating the electro magnet is less than half that required by the average electric horn.

Modern Pipe Casting

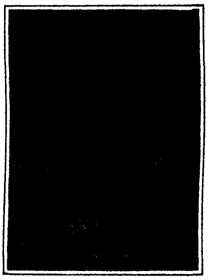
AN interesting development in pipe-foundry labor-saving methods that has come into almost universal use at the present time is the subject of the accompanying illustration. This is a multiple-lip ladle so constructed that it pours from four points at once. Six foot gas and water pipe, and standard five foot soil or waste pipe has always been cast horizontally as in the picture, the multiple pouring having been used, as this gave a more perfect pipe. The shifting of cores and the consequent varying of wall thickness in the pipe was largely eliminated and a more perfect distribution of the liquid metal obtained. [illegible] sary, however, for the [illegible] pouring to make a great [illegible] nearest source of supply [illegible] whether that was the furnace [illegible] bull ladle, filled at the furnace [illegible] to the most advantageous [illegible] pouring also took a long tim[illegible] men could not be put on to [illegible] process as they would merely [illegible] others' way. Each man could [illegible] comparatively smal amount [illegible] the work that could be done [illegible] limited in each instance by [illegible] capacity of the workman inv[illegible]



At work on the Lincoln highway.

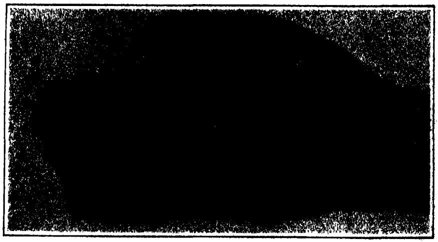


Sawing large cakes of ice into smaller cakes for storage in the ice house.

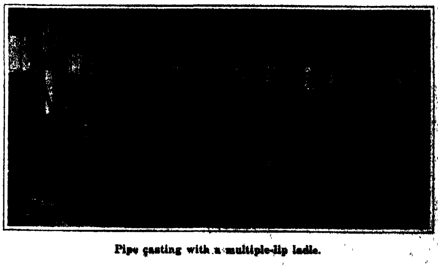


Headlight with reflector cut off.

Headlight with the shutter open.



Pocket wireless receiver for time signals.



Pipe casting with a multiple-lip ladle.

It was to get away from [illegible] limiting factors that induc[illegible] operators to devise and de[illegible] tiple-lip ladle for pipe pour[illegible] ladle is built in the shape of [illegible] iron bath tub, lined of cour[illegible] to prevent its rapid burn[illegible] supported at each end by [illegible] in a bearing formed by the [illegible] an arm that hangs from a cha[illegible] hoist in turn is supported on [illegible] craneway that is part of an ov[illegible] system, centering at the cupol[illegible] and extending over the floor [illegible] which the casting is done.

These ladles are filled directly [illegible] cupola and will hold half a ton o[illegible] iron. The workmen are protected [illegible] great radiated heat of the molten [illegible] shields either fastened to the su[illegible] arms, or, as in the picture, cove[illegible] ladle itself. Long handles attached [illegible] side of the ladle at its opposite ends [illegible] means for tilting and guiding the l[illegible] that it will deliver the iron through th[illegible] lips into the proper openings provid[illegible] the top of the pipe mold.

Vest Pocket Wireless Rece[illegible]

THE value of the new French [illegible] phone" detector, for receiving w[illegible] signals, lies in its very small size and [illegible] pact make-up, so that the whole affair [illegible] be carried in the vest pocket. It is desi[illegible] to meet the growing demand among [illegible] public for a device which will enable a[illegible] one to hear wireless time signals from [illegible] Eiffel Tower station. When it is once [illegible] preciated that the time signals can be tak[illegible] without the use of a complicated device and with little knowledge of electricity, there is no doubt that a much more general use will be made of the wireless time signal system. To show what can be done with the little detector, we may mention that at 20 miles from Paris, all that is needed is an open umbrella held as high as the arm can reach, while a small metal contact piece attached to a cord lies upon the ground and makes the earth connection. At 60 miles one plants a knife in a tree, preferably a pine tree, or a gimlet will answer as well. One of the cords with its metal clip is joined to this "antenna," while the other clip is placed on the ground. The entire receiver weighs but 13 ounces, and yet, in spite of its small size, it is carefully made and is an apparatus of great precision. For long distances, to the extreme borders of France for instance, and even farther, one clip is joined to a telephone line which serves as an antenna, and the other goes to gas or water pipes for the ground. But within 120 miles, all that is needed for the antenna is a kitchen stove or range, balcony, metal bed and the like, and even a bicycle on the road makes a good antenna, or an automobile. The operator may use his body for the ground by attaching the metal clip to his finger, while the other clip goes to the telephone wire. In this way signals were received from Paris at a distance of 270 miles.

A Danish Typewriter Contest.—In a typewriting contest held at Copenhagen, at which machines from leading manufacturers were entered, there were sixty-nine competitors, and about forty of the operators contesting for prizes used American machines. It is interesting to note that the first, second and third prizes were all won on American typewriters, and only two contestants using machines other than American succeeded in receiving [illegible]

How the Locks of the Panama Canal are Operated

The Wonderful Control Boards Which Enable a Single Man to Operate Gates Weighing Tons and to Govern the Course of Thousands of Gallons of Water

The electrical mechanism, which will operate the ponderous locks at Gatun, Miraflores and Pedro Miguel in the Panama Canal, is quite unlike anything used elsewhere in the world. Heretofore it has been the practice to locate a large operating force practically along the length of the locks in a canal. Such a force is difficult to co-ordinate into an efficient operating system. However, the enormity of the Panama locks made it most desirable that all operations should be centralized. The flight of locks at Gatun, for example, extends over a distance of 6,152 feet, and the principal operating machines are distributed over a distance of 4,115 feet.

The Isthmian Canal Commission decided that the locks must be electrically controlled from some central station in each case, because thus the number of operators, the operating expense, and the liability to accidents could be reduced. Great electrical control boards have therefore been especially invented which are installed at Gatun, Miraflores and Pedro Miguel—control boards which are so ingeniously conceived and constructed that a single man, who need never see the ships which are passing through the canal, opens and closes lock gates weighing many tons and governs the course of thousands and thousands of gallons of water.

How the Locks Are Arranged.

Before we can understand how this is done, we must explain how the locks themselves are constructed and what is the character of the lock machinery to be controlled.

As readers of the SCIENTIFIC AMERICAN know, the lock chambers are 1,000 feet long. At each end of a lock chamber, so-called "mitering gates" are to be found, which consist of two massive leaves pivoted on the lock walls and which operate independently of each other. Immediately beyond each pair of mitering gates at each end of a lock chamber a duplicate pair of mitering gates is to be found. These are guard gates. Lastly, still other mitering gates open and close within the lock chamber itself. These, which are called "intermediate mitering gates," are used to divide the 1,000-feet locks into smaller compartments when vessels of short length are to be handled. Thus much water is saved. All the mitering gates, when closed, are clamped tightly together by a device called a "miter forcing machine."

In front of all the mitering gates which are exposed to the upper lock level and also in front of the guard gates at the lower end are chain fenders. These chains are taut when the gates behind are closed and are lowered when the gates are opened for the passing of a ship. The chains are raised and lowered by a method similar to that followed in hydraulic elevators, with the additional feature that if a ship approaches the gate at a dangerous speed and runs into the chains, the chain is paid out in such a way as to stop the ship gradually before it reaches the gates. Two motors lower the chains for the passage of a vessel and raise it again after the vessel has passed. One motor drives the main pump supply water under pressure, and the other operates a valve which controls the direction of movement of the chain. These two operations are combined in one, each motor being stopped automatically by a limit switch when the motor has performed its function.

How the Water Flows from Lock to Lock.

The locks are filled and emptied by three culverts, one in the middle wall and one in each side wall. The flow of water is controlled by what are known as "rising stem valves." These valves are located in the culverts at points opposite each end of each lock, so that the culvert can be shut off at any desired point for filling a lock with water from above, or upstream, or for emptying it by allowing it to flow out and down to the next lock. Lateral culverts conduct the water from the main culverts under the lock chambers and up through openings in the lock floors.

The rising stem valves are installed in pairs, and each pair is a duplicate. Moreover, each culvert is divided into two parallel halves at these valves by a vertical wall. This arrangement reduces the size of each valve, so that it may be more easily operated. Even then, each valve measures 8 by 18 feet and is raised and lowered by a 40 horse-power motor requiring one minute for complete closing. One pair of duplicates is kept open as a guard or reverse pair; the other pair is used for operating, so that in case of an obstruction in the culvert or of an accident to the machinery, the duplicate pair can be used.

At the upper ends of the culverts at the side walls, the duplication is accomplished by three valves in parallel, called the guard valves. Their service is exactly similar to that of the rising stem valves, except that three valves in parallel in this case must conform with the same laws as the two in parallel in the other case.

The culvert in the middle wall must serve the locks on both sides, and to control this feature, cylindrical valves are placed in the lateral culverts that branch out on each side. There are ten of these on each side of the culvert at each lock.

At the upper end of each set of locks, there are two valves in the side walls for regulating the height of water between the upper gates and upper guard gates, as it is desired to maintain the level of the water between these gates at an elevation intermediate between that of the lake above and that of the upper lock when the upper lock is not at the same level as the lakes. These valves are called the auxiliary culvert valves.

Five Hundred Motors Operate the Lock Mechanism.

To give an idea of the number and sizes of the motors to be controlled in operating the lock machinery it may be mentioned that each miter gate leaf is moved by a 25 horse-power motor. There are forty such motors at Gatun, twenty-four at Pedro Miguel, twenty-eight at Miraflores, a total of ninety-two, with an aggregate horse-power of 2,300. Each miter-gate forcing machine is worked by a 7 horse-power motor. Of these motors there are twenty at Gatun, twelve at Pedro Miguel, fourteen at Miraflores, a total of forty-six, with an aggregate horse-power of 322. So, at Gatun, Pedro Miguel and Miraflores there are in all forty-eight motors of 70 horse-power each, which work the main pumps of the fender chains and which have an aggregate horse-power of 3,360; forty-eight motors of ½ horse-power each for operating the valves of the various fender chains and which have an aggregate horse-power of 24; one hundred and sixteen motors of 40 horse-power each which operate the rising stem gate valves; one hundred and twenty motors of 7 horse-power each which operate the cylindrical valves; eighteen motors of 25 horse-power each, which operate the guard valves; and twelve motors of 7 horse-power each which operate the auxiliary culvert valves. Hence, there are five hundred motors of various kinds at Gatun, Pedro Miguel and Miraflores, with an aggregate horse-power of 12,020, to be controlled.

The Wonderful Electrical Control Boards.

The electrical control boards which control all these many motors, valves, and pumps were designed and built at Schenectady, New York, from specifications prepared under the supervision of Mr. Edward Schildhauer, electrical and mechanical engineer of the Isthmian Canal Commission, ably assisted by Engineers C. B. Larzelere, W. R. McCann, and others, and will long be used as models of skilled and painstaking engineering in which every contingency was foreseen and all the safeguards installed that expert engineers could suggest.

The control boards for each lock are to be found in control houses located on the middle walls at points which afford the best view of the locks, although this view is not depended upon to know the position of the gates or other apparatus.

The control boards are approximately operating miniatures of the locks themselves. They have indicating devices which always show the exact position of valves, lock gates, chains and water levels in the various lock chambers, and so far as was necessary are synchronous with the movement of the lock machinery.

The control boards are flat benches 32 inches high by 54 inches wide, built in sections. The board at Gatun is 64 feet long; that at Pedro Miguel 36 feet long and that at Miraflores 52 feet long.

The side and center walls of the locks are represented on the board by cast iron plates and the water in the locks by blue Vermont marble slabs.

The Indicators and How They Work.

In designing the indicators efforts were made to represent the actual machines, the operations of which were to be indicated. For example, the chain fender index consists of a small aluminium chain representing the larger chain of the lock itself. Just as the large chain is lowered into a slot in the bottom of the lock, so the small chain is lowered into a slot in the top of the board. With equal fidelity the miter gate is reproduced. The miter gate indicator consists of a pair of aluminium leaves or pointers which represent a pair of the large miter gates and which move in a horizontal plane just above the marble slab representing the water in the lock. The rising stem valve indicators, however, presented a more serious problem, because the valves themselves are located in a culvert and the operating machinery is concealed below the lock wall; yet for the purpose of observation it was necessary that the indicators project visibly above the surface of the board. The rising stem gate valves of the locks, it has been stated, occur in pairs. For that reason the indicators for these valves have likewise been made in pairs on the board. Each of these indicators may well be likened to a miniature elevator, the car being used to indicate the position of the valve gates. In order that the indication might be visible from various points up and down the board, a novel scheme was resorted to. The underside of the car is equipped with reflectors so arranged as to reflect, parallel to the surface of the board, the light of several incandescent lamps located underneath the board. This light is reflected through openings in the indicator facing both up and down the board, the openings being closed with opal glass. The reflected light gives a sharp shadow on the bottom edge of the car, all portions of the indicator above this line being dark and all portions below being illuminated. The illuminated portions show how far the gate of the valve is open. If the indicator is dark, the valve is entirely closed; if the indicator is illuminated, the valve is entirely open. The one quarter, one half, and three quarter positions of the gate are indicated by heavy black lines on the glass.

For the water level indicator, great accuracy was required. The specifications demanded that the level of the water be indicated to within five eighths of an inch of the actual level, but the indicators attained an accuracy somewhat greater than this. The height of the water is indicated by a rising and falling hollow cylinder having pointers which move over scales. The scales are illuminated by tungsten lamps, located in both the base and the top cap of the indicator.

The indicators for the miter forcing machines, which force the end surfaces of the lock gates into alignment, are not operated by means of position indicator machines. Since all the operator cares to know about them is whether they are in the open or closed position, they are operated merely by control switches.

The open and closed positions of all cylindrical valves are indicated by means of red and green lamps, the intermediate positions not being indicated in any way because the operators need not take cognizance of them.

The Interlocking System, Which Prevents Mistakes.

In order to make it necessary for the operator to maneuver the control switch handles always in a certain order, corresponding with a predetermined sequence of operation of the lock machinery, and to prevent the operator in control of one channel from interfering with the machinery under jurisdiction of the operator controlling the other channel, an elaborate interlocking system has been devised.

The limitations of space forbid an elaborate description of this wonderful interlocking mechanism. The interlocking system is essentially a bell crank mechanism, connecting the shaft of the control switch directly to a movable horizontal bar, forming one of many such bars in an interlocking rack below the control board.

From one of the accompanying detailed illustrations it will be seen that a horizontal connecting rod is used between the cranks on the control switch shaft and the vertical operating shaft. The interlocking rack consists of a rigid frame constructed of three eighths inch thick steel and having five horizontal members. Upon these horizontal members and tying them together are located at convenient intervals a set of vertical straps of three eighths inch by two inch steel. These carry the brass posts that provide the runways for the horizontal and vertical interlocking bars.

The back of the steel strap is grooved and countersunk in such a manner that a key is provided which prevents turning of the posts.

The interlocking system depends mainly on the action of engaging bevel dogs located on the horizontal and vertical bars, the movement of a horizontal bar tending to lift a vertical bar by bevels on the dogs. A horizontal bar cannot be moved without raising a vertical bar. Thus, if at any time a dog on a horizontal bar rests against the upper end of a dog on a vertical bar no movement of the horizontal bar where the dog engages the vertical bar can take place, and the control handle connected with that particular horizontal bar is locked.

The interlocking system forces the attendant to operate the chain fenders, gates and valves always in the proper sequence, and also prevents him from operating

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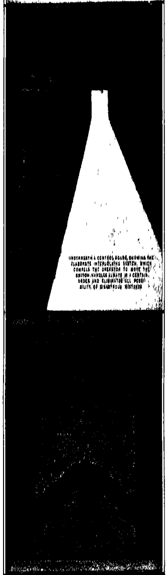
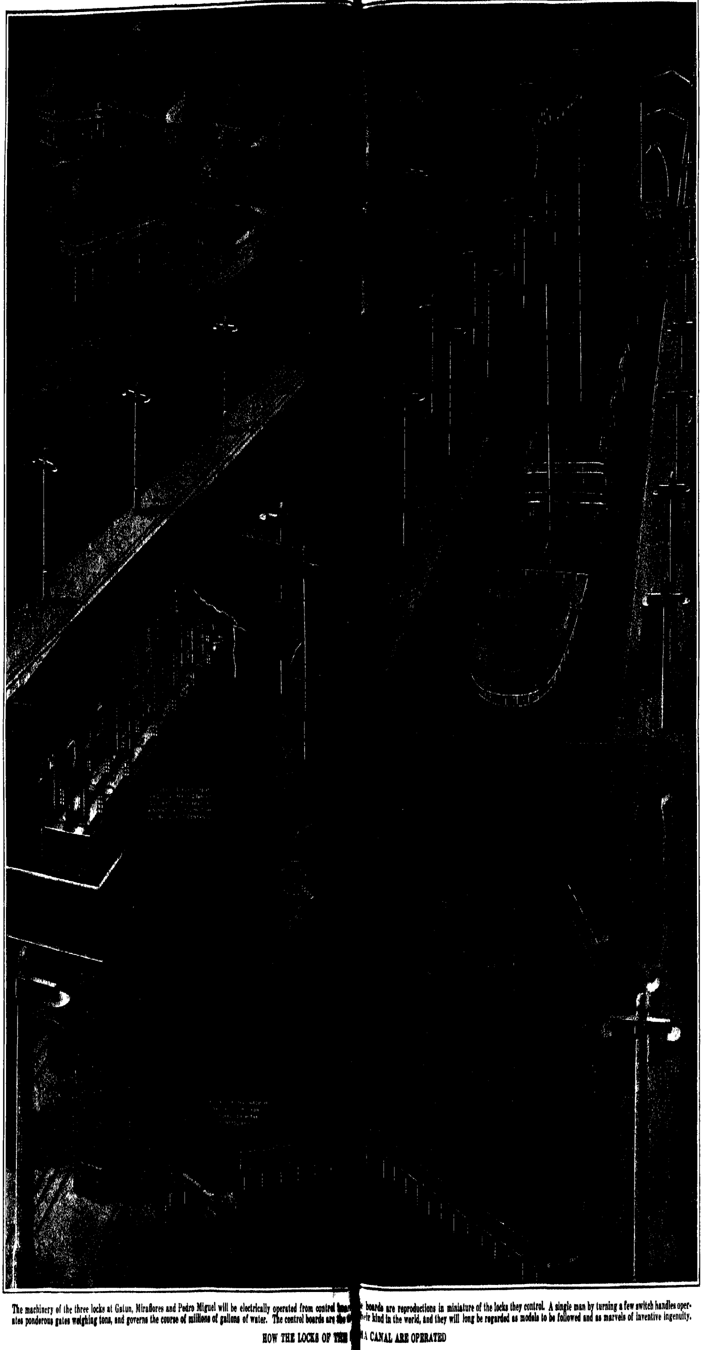


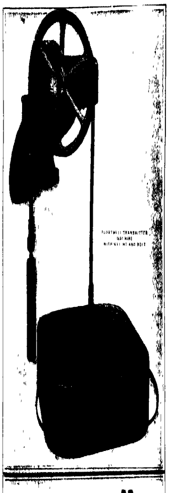
UNDERNEATH A CONTROL BOARD, SHOWING THE ELABORATE INTERLOCKING SYSTEM, WHICH COMPELS THE OPERATOR TO MOVE THE SWITCH HANDLES ALWAYS IN A CERTAIN ORDER AND ELIMINATES ALL POSSIBILITY OF DISASTROUS MISTAKES

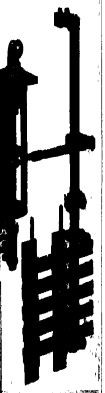
The indicating devices on the control boards show the positions of the rising stem and other valves, lock gates and the water level as it changes in the various locks and in the forebay.



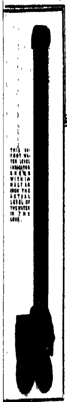
The machinery of the three locks at Gatun, Miraflores and Pedro Miguel will be electrically operated from control boar e boards are reproductions in miniature of the locks they control. A single man by turning a few switch handles operates ponderous gates weighing tons, and governs the course of millions of gallons of water. The control boards are the heir kind in the world, and they will long be regarded as models to be followed and as marvels of inventive ingenuity.

HOW THE LOCKS OF THE A CANAL ARE OPERATED

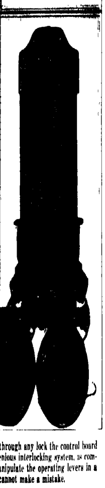




THE INTERLOCK SYSTEM IS ESSENTIALLY A BELL CRANK MECHANISM, CONNECTING THE SHAFT OF THE CENTRAL SWITCH THROUGH A MOVABLE HORIZONTAL BAR WITH A VERTICAL OPERATING SHAFT WHICH CAN OR CAN NOT MOVE ACCORDING TO THE RELATIVE POSITIONS OF THE INTERLOCKING BARS AND DOGS



THIS 50-FOOT WATER LEVEL INDICATOR SHOWS WITHIN HALF AN INCH THE ACTUAL LEVEL OF THE WATER IN THE LOCK.

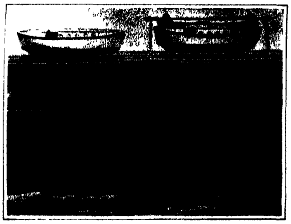


THE RISING STEM VALVE INDICATOR

In passing a vessel through any lock the control board operator, by an ingenious interlocking system, is compelled always to manipulate the operating levers in a definite order. He cannot make a mistake.

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks



Picked up by the crane.

Waiting for a favorable wave.

A sheer drop of ten feet.

A Motor Lifeboat With a Cabin

No matter how safe a vessel may be rendered by means of bulkheads and double bottoms extending well above the waterline, the danger of fire, of a boiler explosion or of pounding to pieces on rocks or shoals makes it essential that every vessel be fitted with lifeboats. Recent disasters at sea show how difficult it is to launch a lifeboat of the ordinary type from a vessel in time of storm and also how readily the ordinary open lifeboat may be swamped. At the recent Motorboat Show held in New York a motor lifeboat was exhibited which was identical in design with the self-righting, self-bailing motor lifeboat used in the United States Life Saving Service, with the additional feature of a completely inclosed cabin. The boat is 36 feet long and provided with a 35 to 40 horse-power internal combustion engine capable of driving it at a speed of 10 to 11 miles per hour, fully loaded. The engine which may be operated on gasoline, kerosene or distillate fuel is placed in a water-tight compartment in the stern with all the controls on the outside, so that there would be no chance for the engine to be overwhelmed by a wave. Furthermore, the smoke and engine smells are kept out of the cabin. The gasoline tanks are on the outside and above the waterline where any leak would drain overboard. Into the cabin 60 or 70 passengers may be crowded and kept where their frantic and hysterical actions will not bother the pilot of the boat. In addition to the engine the boat is provided with a wireless telegraph system whereby communication could be established with rescue ships.

As the principal danger lies in the launching of a lifeboat, the builders of this lifeboat had designed a simple launching system, the rudimentary principles of which are shown in the accompanying illustration. On the boat deck a system of tracks is laid and the lifeboats are supported on roller trucks which run along the tracks and are thus brought to the launching point on the leeward side. Here they are picked up by a simple crane consisting of a pair of arms fulcrumed at the side of the vessel and connected at their outer ends by a cross-arm. By means of an automatic clutch the boat is instantly secured to the cross-arm and then the crane is swung out over the side of the vessel, coming to rest with the keel of the lifeboat about 15 feet lower than the boat deck. Here the lifeboat is supported far enough out to prevent it from being smashed against the side of the vessel. The pilot then awaits his opportunity. As soon as a wave dashes up to within 10 feet of the keel of the lifeboat he operates a release lever which drops the boat into the water. The lifeboat is so stanchly constructed that it may take a drop of 10 feet or even more without injury. As soon as it strikes the water it is carried off from the boat by the receding wave, and the engine which previously has been started, immediately carries it clear of the wreck. In case conditions do not permit of dropping the boat directly into the water, an inclined monorail system has been designed which may be attached to the side of the boat in such manner that it may fold against the hull or may be extended, when desired, so that it will form an extension of the cross-arm of the crane. Down this inclined monorail the boat glides under control of the operator until it reaches a point where it may be dropped into the water. It is impossible for us to judge of the practicability of these proposed launching methods as we have not been acquainted with the essential details. The boat, however, whether launched in this manner or by well-known methods now in use, should prove almost invaluable in case of a serious accident at sea.

A self-righting, self-bailing, motor lifeboat with cabin accommodating sixty passengers.

The Molecular Air Pump

A great deal of interest has recently been aroused in the introduction, by Dr. Gaede, of an interesting type of air pump. It has particular value in connection with the exhaust of gases from bulbs, tubes, and similar apparatus requiring a high internal vacuum.

The principle of the apparatus is shown in Fig. 1. A is a cylinder fixed on a shaft a and inclosed in a casing B, into which is cut a groove reaching from n to m. When the cylinder A rotates as shown by the arrow, the air contained in the groove is entrained from n to m by the friction. On connecting a gage o to the apertures m and n by pieces of rubber tubing S, it shows a difference of pressure between m and n. The level of the mercury rises to the point p and is depressed to o at the other end. The difference of pressure is proportional to the number of revolutions of the cylinder A and the internal friction of the gas.

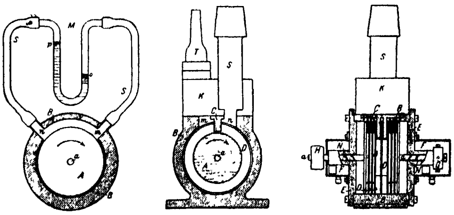


Fig. 1 Fig 2 Fig. 3

Diagram and sectional views of the new vacuum pump.

This internal friction, according to the kinetic theory of gas, is produced by the collisions continually occurring between the moving molecules of the gas. The molecules move with a very high velocity in rectilinear paths, the direction of which is absolutely irregular until they meet with other molecules. At ordinary pressure the result of this is an irregular, zigzag motion. At very low pressures, however, the collisions of molecules among each other become very rare owing to the high degree of rarefaction, so that the molecules of the gas may be said to impinge exclusively on the walls of the vessel containing them. From the walls the molecules are reflected quite irregularly, the angle of reflection being independent of the angle of incidence. If the surface of the cylinder A moves with a higher velocity than the molecular velocity of the gases, the effect of vessel moving to the right with a higher velocity than that of the molecules projected out of it to the left is that the molecules projected toward the point n are nevertheless entrained to the right in the direction of the arrow in the figure. No molecules reflected from the cylinder will therefore reach the aperture, which will be a region of fewer molecules—in other words, a vacuum will be formed at n.

Evidently this pumping arrangement is not so useful at atmospheric pressure as at low pressure in connection with a backing or rough pump, as the action of the pump is based on the molecular action of the gases. Figs. 2 and 3 show the actual construction of the cylinder A fixed on the shaft, a in the case B. The shaft runs in bearings provided in the end-plates E of the cylindrical casing which are screwed on air-tight. The grooves D are cut into the cylinder, and the tongues C which are fixed on the casing project into the grooves. F are the oil tanks, G is an adjusting gear by which the tongues C are kept from touching the rotating walls of the grooves. H is the pulley. When A rotates clockwise, the air is compressed at m and rarefied at n. The extension K is fixed by screws on the casing B, forming an air-tight joint. S is the suction nozzle which communicates with the space n in the casing, the groove D shown in the cut being the central groove of the pump. The discharge air pressure opening m of this groove is connected with the suction opening of the adjoining groove by a channel bored in the extension K, the pressure opening of the

(Continued on page 216.)

Fig. 4.—General view of the molecular pump.

Fig. 5.—Pump belted to a motor which drives it at 8,000 to 12,000 revolutions per minute.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

ADJUSTABLE BANDEAU FOR LADIES' HATS.—B. WERTHEIMER, care of F. F. Eiseman, 41 Park Row, New York, N. Y. This invention provides an adjustable bandeau for ladies' hats, arranged to enable the milliner or other person to readily increase the size of the bearing portion of the bandeau to suit the head of the customer, thus insuring a proper fit of the hat.

CORSET COVER.—L. T. FURNAS, Lima, Ohio. This invention refers to a garment in the form of a corset cover or brassière which is adapted for contraction or expansion at both top and bottom and intermediately on a vertical median line for giving a desired contour to the bust and waist.

Pertaining to Aviation.

AEROPLANE.—A. E. HOLBROOK, Joplin, Mo. The purpose here is to provide a machine wherein a maximum of lifting surface is obtained with the smallest possible amount of weight, wherein the balancing will be automatic, and wherein a plurality of rudders is provided operated by a single shaft.

FLYING MACHINE.—R M METCALF, Route 3, Valley City, N. D. This invention relates to a flying machine of that type known as self propelled aeroplanes; and the aim is to provide a device which will be simple, of light weight and great strength, which will run at a high speed and in a steady manner, and which will be capable of easy control.

Of Interest to Farmers.

CULTIVATOR.—R. DINSE, Stanwood, Iowa. The object here is to provide a device by means of which plants in rows may be cultivated on all sides, while the cultivator is moving longitudinally of the rows, thus dispensing with the necessity for hoeing or cultivating at right angles to the direction of the rows

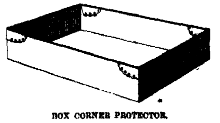
LINE GUIDE -A. C. OHNSMAN, care of J. L. Ohnsman, Sta. A, Route No. 5, Columbus, Ohio. The object here is the provision of easily transportable means for holding a line at each end of the field to be planted, so arranged that the line will be held tight during the planting, and when the row is planted the succeeding line will be indicated.

ELECTRICAL AGRICULTURAL SYSTEM.—C. S. DONEY, Wallace, Idaho This invention provides a means for supplying power to agricultural tractors or motor vehicles such as gang plows, cultivators, seeders and the like, which will permit them readily to move over the ground. It provides means whereby a trolley on the motor vehicle will move the wires from which it receives current to and fro as the tractor traverses the field.

WIRE WINDER—C. B. RUBY, Le Mars, Iowa. The inventor provides a device wherein means is provided for holding and rotating a reel, together with means capable of being operated from a point adjacent to the reel, for constraining the wire to wind in uniform layers upon the reel. When taking down a fence, the frame may be moved as a sled or with wheels, winding up the wire as the device moves along the fence.

Of General Interest.

BOX CORNER PROTECTOR—KATHERINE M. BLACK, 407 E. 11th St, Austin, Tex. This protector is constructed of a piece of metal with an angular cutaway portion at its inner side so that the piece of metal may be bent longitudinally and transversely through the apex of the angle formed by the cutaway portion to fit a corner of the box or box lid without the inner side of the piece of metal overlapping. The edge of the piece of metal is scalloped, and the edges of the scallops are turned inward to engage the surfaces of the sides of the box to obtain a grip thereon and prevent protruding edges of metal from catching goods in the box. The outer sides of the metal have punched portions forming spurs which project inward and which engage similar spurs on the inner sides of the metal, which project outward.

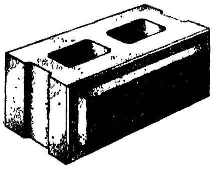


BOX CORNER PROTECTOR.

MOLD FOR EARTHENWARE.—A. FOLTZ, Lambertsville, N. J Address L. P. Kugler, same place. An object of the inventor is to provide a device by means of which an article, such as a tank, may be molded by passing a stream of water containing particles of clay or other suitable materials in suspension, into the mold, where the clay is deposited, the water being forced out by pressure.

TABLET.—W. K. WATERMAN, 12 South 18th St., Flushing, New York, N. Y. This tablet is for use on the outside of office buildings, stores, banks, etc., and arranged to be legible during the day and night by evenly illuminating the panel or background to render the opaque letters distinctly visible, project but little from the face of the structure to which the tablet is attached, and to give the tablet an exceedingly artistic appearance.

BUILDING BLOCK AND METHOD OF FORMING THE SAME.—F. AARONSON, Manasquan, N. J This invention provides blocks with undressed faces; provides said blocks with roughened faces, such faces being formed without design; provides a molded block having an unmolded face and provides a block having a face roughened by forcibly separating said face from a body of the same material, The grain of the material, instead of being, as at present, closed or filled, has much of the porosity of fracture lines of a natural rock.



BUILDING BLOCK.

MOUSE PROOF PIANO PEDAL—R BOLLERMAN, care of Bollerman & Son, 271 E 132nd St., Bronx, N Y This invention has particular reference to means for effectively excluding mice from the interior of the piano The invention provides a means for use in connection with a piano pedal which will automatically close the opening ordinarily left by the pedal when in its normal elevated position

TRUSS.—J T HAILE, Utopia, Tex The invention provides certain improvements with respect both to the truss pad and the adjustable connections for securing the same to the wearer, whereby to form a more sanitary, more comfortable and more beneficial device than is now in use.

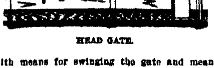
ELEVATED CARRIER—A. D HADSEL, care of Cable Excavator Co., 410 Arcade Bldg, Philadelphia, Pa. This carrier includes a cableway which may be of considerable length and along which is adapted to be operated a main carriage for the purpose of supporting any suitable form of excavator bucket or means for handling material in general, including the loading and unloading of barges or other craft or transfer of vessels to cars or handling of stone in quarries or the like.

COMBINATION WRITING PAPER AND ENVELOP TABLET—J ANDERSON, U S. S "Utah," care of Postmaster, New York, N Y The invention relates particularly to a tablet in which sheets of writing paper and a series of envelop blanks are so combined that the paper and the blanks have a compact and convenient arrangement, with the blanks spread out in flat form and superposed one on another, the paper and the blanks being held to stubs defined by lines of perforations or their equivalent, so that the letter sheets and blanks can be readily detached as required for use

PROCESS OF MOUNTING EYE SPECIMENS.—F L. BARROWS, Moscow, Idaho The process consists in placing fresh eyes (preferably pig or sheep) for mounting in a formalin solution to harden the same, then freezing and dividing them into two parts, keeping such parts immersed in an aqueous solution until the vitreous portion has dissolved out and gelatin has taken its place; then removing the eye portions and immersing them in soft gelatin to solidify

HOLDER FOR PACKING BOXES.—NETTIE C LYND, Oregon City, Ore. An object of this invention is to provide a holder for packing-boxes such as boxes or crates used in packing oranges, grape fruit, or other fruit which will obviate the necessity of lifting the box and turning it around during the packing operation

HEAD GATE.—J T FITCH, Helper, Utah. The object of the invention is to provide a simple, strong, inexpensive and balanced gate which can be quickly and easily operated and which is provided with means for indicating the size of opening formed by the gate This invention provides a gate adapted to swing in a plane normal to the flow through the gate, with means for swinging the gate and means indicating the size of opening made by the gate The gate being centrally pivoted in a vertical axis, the pressure of water in the gate at any position of the gate is necessarily balanced; thus no extra power is required to operate the gate.

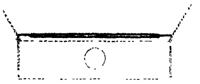


HEAD GATE.

NON-REFILLABLE CIGAR BOX.—J. GAGLIANO, 122 Jamaica Ave., Astoria, N. Y., N Y. This invention provides means for handling or dispensing the better grades of cigars, cigarettes or the like. It provides a means whereby cigars may be handled in bulk in such form that the individual cigars cannot be touched or handled, and hence are kept in a perfectly clean and sanitary condition

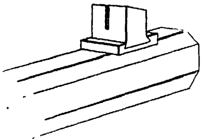
HORSE OVERSHOE—J J. O'CONNELL, R F. D. No. 1, Box 119, Ridgewood, N. J The invention pertains to farriery and has particular reference to a temporary attachment or overshoe to be applied in slippery or icy weather to prevent the ordinary horseshoe from slipping when the calks thereof, because of being blunt or otherwise, will not hold the horse securely

STRAINER ATTACHMENT—G BENDIX, Vesta, Minn The purpose here is to provide a device whereby a strainer for milk or other fluids may be quickly repaired without the necessity of dismantling the device The article may be used with an ordinary milk strainer and its use will practically render the strainer as good as new. An annular ring with the screen or wire cloth is made up in various sizes to accommodate strainers of greater or less capacity. The rings are made full width so that they may be trimmed if necessary Ordinarily, however, this would not be required



STRAINER ATTACHMENT.

FRONT GUN SIGHT.—A. J EVANS, Box 157, Mosier, Ore. The purpose of this sight is to secure greater accuracy in elevation and line in target and game shooting It is of the type of leaf or block sights having a notch or vertical slot in the center In practice, when the sight is used on military and sporting guns, the surface next to the eye should be finely matted or black The sight permits an unobstructed vision of the bull's eye or target, and in raising the gun the horizontal line of the top of the sight quickly indicates the required elevation, while the vertical slot quickly directs the vision in line with the objects



FRONT GUN SIGHT

CAPSULE—M H SMITH 105 Chamber St, New York, N Y This capsule is provided at its inner face with a raised identification mark of the same material as the capsule and integral therewith, the capsule being filled with a liquid medicine having approximately the same index of refraction as the capsule so that the identification mark is not discernible from the outside

PROCESS OF PRODUCING A PHOTOGRAPHIC REPRODUCTION FOR USE IN MAKING BAS-RELIEF—G M CARPENTIER, 175 W 95th St, New York, N. Y This invention relates to a process for producing photographic reproductions in relief of designs paintings engravings, or photographs of any description with absolute fidelity of form and in any given size of the objects or figures the artist intended to represent.

Hardware and Tools.

PNEUMATIC TOOL—E M TOBIN, Barre, Vt. The invention relates to improvements in pneumatic tools, and particularly to what are known as pneumatic hammers, and has for an object to provide a structure wherein the various moving parts are reduced to a minimum, and the action is without unnecessary vibration or jars

DENTAL MASSAGE IMPLEMENT—M POUNDER and F. F HANSKE, Munger Bldg, Elkhart, Ind. The object here is to provide an inexpensive implement which may be used to massage the gums of the oral cavity to provide and stimulate healthy circulation of blood in the gums and by these means prevent and cure various diseases of the gums, including congested and receding gums

SCREENING-SHOVEL—O THIBAULT Box 548, Fall River, Mass In this instance the invention is an improvement in the class of shovels adapted for screening or sifting cinders coal, and other like commodities The shovel blade is formed of wrought iron or steel struck up in dies into the required form, and it may be cheaply and easily produced by means of cutting and shaping dies.

HINGE.—W. N BLANCHARD, 2215 Gaty Ave., East St. Louis, Ill The object here is to provide a hinge for general use, wherein the principal portion of the mechanism is arranged within the members to be hinged together, and means is provided in connection with the said mechanism for engagement by a cover, hood or blind to conceal the joint and the hinge

BELT FASTENER—J. EVANS, JR and JAMES EVANS, care of W. P Davis, 909 W North Temple St., Salt Lake City, Utah The invention pertains to fasteners in which a plate is provided with spaced fingers comprising, in general, the form of a club plate, the fingers being designed to be passed through holes adjacent to the meeting ends of the belt, the free ends of the fingers having means for preventing their accidental withdrawal

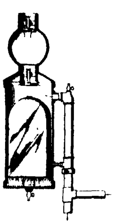
UNDERREAMER G A MONTGOMERY Box 76, Oilfields, Cal This invention is for use for enlarging a drill hole previously formed with an ordinary club bit in drilling for crude oil, and provides a large area of wearing surfaces between the cutters and their supporting elements, provides a construction in which these surfaces will be largely protected against the entrance of abrasive matter provides perfect seats for the cutters, makes provision for preventing the losing of the reamer cutters, promotes convenience in adjusting the reamer in position to be lowered into the well and, provides an underreamer the body of which is free from subjoints

UNDERREAMER FOR ENLARGING DRILL HOLES

CIGAR TUCK CUTTER G W BOWMAN, 409 S George St, York, Pa The general object in this case is to improve the construction of the retaining device and guard so as to be more flexible and engage the cigar when in position to be cut with just enough pressure as to hold it in co-operative relation with the cutters without danger of breaking the cigar which will effectually prevent the cigar being held by the operator while being cut

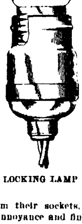
Heating and Lighting.

VALVE FOR VACUUM HEATING SYSTEMS A PORTER, Marquoketa Iowa An object of the inventor is to provide a steam heating system in which a vacuum is obtained by the condensation of steam air being prevented from entering the pipes by an air valve of special construction A further object is to provide means for permitting the escape of air when the steam pressure rises above atmospheric pressure



VALVE FOR VACUUM HEATING SYSTEMS

SELF LOCKING LAMP BULB—C BLASS, 312 Milford St Brooklyn, N Y This invention relates to electric lighting devices and has particular reference to a means for preventing the unauthorized removal of incandescent electric lamps from their sockets, a source of a great deal of annoyance and financial loss incident to the use of such lamps in public places Locking means co-operate between the lamp base and its socket, which operates automatic



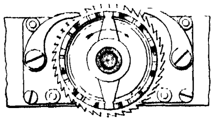
SELF LOCKING LAMP BULB.

ally to secure the parts together and which requires a special form of key for unlocking

LIQUID FUEL BURNER.—G E DENMAN, 3558 Custer St, Fruitvale, Cal This invention has reference more particularly to the class of device comprising an inner and an outer casing having independent inlets, one for fuel and the other for the compressed fluid, and a tip body secured to both of said casings and through which the liquid fluid is forced by means of compressed fluid.

OIL BURNER J A TRIMBLE and C H. MILLER, 5483 36th Ave, S E Portland, Ore The inventors have found in practice that the burner is very efficient, and the advantages obtained are due to heating the air and other gases before they enter the mixing chamber, so as to raise the temperature of the oil and make the same readily ignitible They thus accomplish a great saving of fuel, besides the uniform flame and even heating effect which the burner affords

CRANKING DEVICE.—T McCABE, Homestead, Pa This device is for use on gas or gasoline engines An object of the inventor is to provide a device especially adapted for use on automobiles and gasoline engines, the construction being such that the brakes must be set and the speed change lever must be in neutral position before the cranking can take place, and in the event of a back fire from the engine the crank will immediately disengage from the engine shaft The use of the device is intended also to prevent injury to a person while cranking an explosive engine



CRANKING DEVICE.

Household Utilities.

COOKING UTENSIL.—G W BLODGETT, 387 E Washington St, Portland, Ore The inventor's purpose is to provide a cover for the vessel which will prevent cooking without liquid in the vessel, and also condense the vapors formed during cooking and return the same to the vessel This is obtained by providing a cover formed of a series of superposed members having a large condensing surface

WASTE AND VENT SYSTEM C S C ROCK 204 W 140th St, New York, N Y The object here is to provide a system having a plumber's fitting designed to connect the soil pipe with the vent pipe and adapted to connect with bath tubs, sinks, water closets and other fixtures to be drained and vented, the arrangements being such that the plumber can readily assemble the parts and make the desired connections and that proper drainage and venting is insured

COOKER R W RYON 304 3rd St, S E, Washington D C An object in this case is to provide a device in which the cooking of such articles as sausages may be conducted while at the same time the heating of other articles, such as rolls, may be accomplished with means for permitting the flavor or essence of the sausages to be absorbed by the rolls

COMBINATION SUPPLY AND WASTE FIXTURE FOR LAVATORIES W A SPEAKMAN care of Speakman Supply and Pipe Co, Wilmington, Del Among the objects of this invention is to provide a fixture of unusually simple and neat design whereby the manipulation of the fixture is facilitated and the device rendered more reliable than previous ones. Further, to provide a water supply fixture for lavatories which is adapted to be used in connection with standard basins without alteration thereof

DISPENSING BOWL S A ADDIS, 944 Tiffany St Bronx, N Y, N Y This invention relates particularly to an improved bowl for dispensing sugar and other similar material, and has for an object to provide an improved structure which will allow the dispensing of measured quantities of sugar, and will prevent any wasting thereof

GAS RANGE BURNER.—E S ALLEN, 517 E 134th St, New York, N Y The improvement has reference to gas range burners, and the invention comprehends a burner provided with a valve, said valve being controllable by the position of a grid or spider associated with the burner for the purpose of supporting pans or other articles to be heated

Machines and Mechanical Devices.

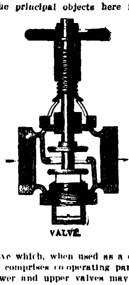
THREAD CUTTING MACHINE.—J A DOWD, P O Box 488, Fall River, Mass This invention refers to improvements in machines for cutting threads upon pipes, bars and the like, and for severing the pipes and bars at desired lengths The purpose is to provide a structure which will continually operate for threading a pipe, bar or the like and intermittently severing the pipe or bar into lengths

SHAPING ROLLS FOR HORSESHOE BARS —L. T. PAGE, Box 104, Wareham, Mass The invention provides means for mechanically creasing and partially punching the bars from which horseshoes are subsequently made; prevents the creeping or misregistering of the rolls with the bars and shoe-forming sections thereof, and reduces the friction offered by the bars to the rolls when passing therethrough

MIXING AND SIFTING MACHINE.—S. L. HARWOOD, Dublin, Ga This apparatus is for use in mixing and sifting fertilizing materials, and the machine will deliver a mixture which is very uniform, instead of discharging the fine ingredients of the mixture first and depositing the finer part of the mixture in the bottom of the sacks which receive it, an objection met heretofore in devices of this sort

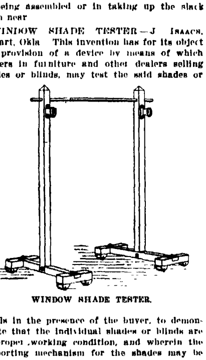
MARINE SAFETY DEVICE.—M. BOUCHET, 22 Rue Alphonse de Neuville, Paris, France. The inventor provides for increasing the buoyancy of the vessel at certain critical times when danger may accrue from undue pressure of water outside of the vessel, thus tending to crush the vessel inwardly, or from excessive air pressure inside of the vessel, having a tendency to disrupt the vessel or some portion thereof

VALVE.—A E CRUM, Mobile, Ala. This invention relates more particularly to a structure comprising a casing which permits the use of parts whereby a double acting or a single-acting valve construction is provided One of the principal objects here is to provide a valve which, when used as a double acting valve, comprises co-operating parts, whereby the lower and upper valves may be accurately adjusted on their seats when the valve is being assembled or in taking up the slack from wear



VALVE.

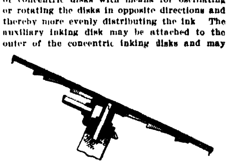
WINDOW SHADE TESTER.—J ISAACS, Hobart, Okla This invention has for its object the provision of a device by means of which dealers in furniture and other dealers selling shades or blinds, may test the said shades or blinds in the presence of the buyer, to demonstrate that the individual shades or blinds are in proper working condition, and wherein the supporting mechanism for the shades may be adjusted to any size of shade



WINDOW SHADE TESTER.

CLOTH WORKING MACHINE.—G H WIEMANN, 262 N. 6th St Brooklyn, N Y This machine winds or bolts quantities of cloth piled up in folds, each layer being separated from the layer above and below the same by sheets of paper or similar material The sheets of paper are continuously removed by the machine at the same time that the operation of winding the cloth is in progress

INKING DISK FOR PRINTING PRESSES.—F J ANTELOTTI, Norfolk, Va. This invention provides an auxiliary disk which may be used in connection with printing presses having inking mechanism consisting of a plurality of concentric disks with means for oscillating or rotating the disks in opposite directions and thereby more evenly distributing the ink The auxiliary inking disk may be attached to the outer of the concentric inking disks and may be spaced from the inner of said disks, thereby permitting the free movement of the inner disk A cover for the inner and outer inking disks serves as an inking disk itself, and when removed permits the inking to be done by the inner and outer concentric disks which form part of the normal structure of a machine.



INKING DISK FOR PRINTING PRESSES

LOOM SHUTTLE.—W H. WILSON, 7 Bedford St., New Bedford, Mass This shuttle is arranged to prevent the slack of the thread and consequent breaking thereof, and to prevent the thread from accidentally passing out of the eye at the end of the shuttle at the time the shuttle advances from the shuttle box toward the cloth, as at this time the thread is liable to curl up and break on further advance of the shuttle.

STRAP AND TAB FORMING MACHINE.—F METZENBACHER, care of W. H. Rich & Son, 708 Pacific Street, Brooklyn, N. Y. This machine is for use in the manufacture of umbrellas and other like purposes, and has reference more particularly to a machine of this class which comprise a strip forming mechanism, a cutter for severing the formed strip into lengths to produce straps or tabs, and means for simultaneously operating the strip forming mechanism and the cutter.

ALARM CLOCK ATTACHMENT.—R. P. PACKARD, 3717 6th Ave, Tacoma, Wash. The device is for use in connection with ordinary alarm clocks, and the aim thereof is to cause a lamp to be lighted when the alarm is rung. It comprises connections which are controlled by the position of the parts of the alarm mechanism and are so arranged further that the lamp can be caused to remain lighted so that the same can be kept in use after the alarm has ceased

SHUTTLE MACHINE EMBROIDERY FRAME.—H HOCHREUTENER, 708 Highpoint Ave, West Hoboken, N J This invention relates to improvements in frames for embroidery machines and to what are called section frames, and has for an object to provide improved structures in which no waste spaces are provided Means provide for the ready removal at times of the articles to be embroidered.

Prime Movers and Their Accessories.

INTERNAL COMBUSTION ENGINE.—N H SCHICKEL, 50 Garden St, Stamford, Conn. The object of the invention is to provide a feeding mechanism for internal combustion engines, such that the fluid to be fed will be displaced from the pumping chamber and transferred to the working cylinder in a substantially uncompressed state while the inlet port is open.

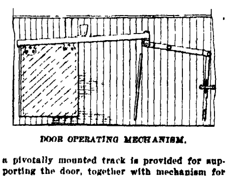
FLUID OPERATED ROTARY PRIME MOVER.—G H ALEXANDER and W G ROBINSON, respectively at Doe St, and 5 Elm Cottages, Falconer Road, Birmingham, England This invention relates to such fluid operated rotary prime movers as rotary internal combustion, steam, water and air engines, of the type in which a pair of cylinders and pistons is arranged parallel with each of a pair of axes mounted at an angle to each other, and the pistons are connected by suitable links with the members of a Hookes' or universal joint situated at the junction of the axes.

Railways and Their Accessories.

CONCRETE RAILWAY TIE.—R. T BAGBY, Whitney, N. C The object in this case is to provide a strong, inexpensive and stable tie which has large bearing areas in the road ballast for each of the rails, and the center of which area is substantially in alinement with the axis of the rail

GATE OPERATING MECHANISM.—J. E C. JACOBSEN, 29 Fourth Ave, Nyack, N Y., and C A V J SEGERSTEN, Nyack, N. Y This invention comprehends mechanism whereby a train in approaching a predetermined part of a track provided with gates will cause the gate to close automatically, will actuate lamps serving as alarms, and will retain the gates closed and the alarm active so long as the train is present, but when the train departs, the gates are automatically opened and the alarm rendered inactive.

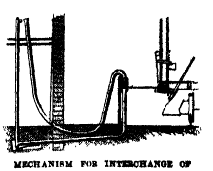
DOOR OPERATING MECHANISM.—W E HARRIS, care of Scott Mfg Co., Houston, Tex The object here is to provide mechanism especially adapted for freight car doors, wherein a pivotally mounted track is provided for supporting the door, together with mechanism for swinging the track, in order to utilize the weight of the door in opening and closing the same



DOOR OPERATING MECHANISM.

RAIL FASTENING.—L. FAUQUÉ, 52 Rue de Louviers, St-Germain-en-Laye (Seine-et-Oise), France. This invention insures the fixation of the rail by means of a device offering a resistance to the pulling stress always equal to the breaking strain of the metal of which it is constituted, allowing without any screw threading, a much more secure clamping than that of the screw spike and opposing any sinking of the rail on its supports, all these conditions being necessary for insuring the fixation of the rails of the wooden sleepers made of any species of wood.

MEANS FOR INTERCHANGE OF MESSAGES BETWEEN A STATION AND A MOVING CAR.—O. H. SMITH and J. L. SMITH, Stratford, Penn. Address the former. This invention relates to mechanism of the character set forth in a previous patent, No. 1,042,988, issued to these inventors. It provides a system of tubing leading from a railway station or other building in the proximity to a railway track, such tubing being adapted to deliver carriers to and from a car, such carriers being secured and deposited by the car as it moves along.



MECHANISM FOR INTERCHANGE OF MESSAGES.

Pertaining to Vehicles.

SPRING HUB.—W. H. LASSWELL, care Savoy Hotel, San Antonio, Tex. This hub is for use in automobiles and other vehicles, wherein yielding mechanism is provided within the hub, between the spindle and the wheel, for cushioning the vehicle against jar and jolting, and wherein yielding mechanism is concealed from view and protected from external injury and the entrance of dust and the like

SHOCK ABSORBER.—J. H NEDER, 2437 Center St, Baker City, Ore This absorber protects the arched springs of a vehicle from breakage due to sudden rebound of the springs as the vehicle passes over an obstruction or rough ground. The absorber is in the form of a helical spring readily attachable to the arched springs of the vehicle, which shall be noiseless.

RESILIENT TIRE.—R. E. LEAS, care of Nelson Bros, Luverne, Minn In this wheel the tread is movable relatively to the felly through the medium of ball bearings and springs, such parts being permanently inclosed, whereby they are kept free from entrance of dust and foreign matter Provision is made for maintaining the bearings in a constant state of lubrication

TIRE SPREADING DEVICE.—J. O. STEWART, 1201 First Ave, Spokane, Wash In the present patent the invention refers to improvements in tire spreading devices, and has for an object the provision of an improved structure for spreading a clincher tire structure so as to permit ready inspection of the interior thereof.

DOOR FOR AUTOMOBILES.—W. G. MINER, Sayler Park Station, Cincinnati, Ohio Doors of automobiles are ordinarily arranged to swing outward The inventor has devised an improvement by which doors are adapted to slide horizontally in guideways and pockets provided in the body of the vehicle, and he has provided such doors with spring attachments as a means or aid for closing them

WHIP HOLDER.—F F PROVAN, Marion, N. D. The invention comprises means for engaging the doubletree of the leading team or other fixed support and a holder proper for the whip hinged to the said means for swinging movement, together with means operable from a distance for swinging the holder, and other means for returning the holder to upright position, the holder having means for clamping a whip

Designs.

DESIGN FOR A GOBLET.—E. W. NEWTON, Chicago, Ill. This ornamental design for a goblet shows an article of rather tall form with a slim stem and plain base, the side view presenting a gracefully waved outline

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NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12941) A. W. F. asks: Will you be kind enough to tell how to make a selenium cell, or, at least, what materials are used as contacts, and how? I have a piece of crystal selenium Do you think that I could make a cell with this piece sensitive enough to close a 150-ohm relay when the rays of an ordinary tungsten lamp are allowed to fall upon it? A. We would advise you that you cannot use a lump of selenium as a selenium cell. It is not sensitive to light The selenium must be treated to render it sensitive to light by heating for a long time. The cell is made by coating wires with the selenium so that the current may flow from one wire to the other through the sensitive coating. The whole process is described in the Scientific American and the Supplement in a number of papers We name Supplement Nos. 1430, 1881, 1882, 1883, 1897, 1719, 1912, and the Scientific American, Vol 100, No. 11, and Vol. 107, No. 21. We will send the nine papers for 90 cents. With these you will have full instructions how to proceed as well as full information upon the general subject of a selenium cell.

(12942) L. J. S. asks: 1. We have recently inquired if it is possible for you to inform us why vacuum bottles are covered inside with nitrate of silver. Does this process increase the efficiency of the bottle? Also, please inform us if there is any literature published on this subject? A. The vacuum bottles about which you inquire are coated with metallic silver and not with nitrate of silver This last is a white crystalline substance which is readily soluble in water and could not be made to coat glass The metallic silver is deposited upon the outer side of the inner bottle and the inner of the outer bottle so that there are two coatings of silver The object is to prevent the passage of heat A polished surface is a good reflector and poor absorber of heat Hence the outer surface of the bottle reflects most of the heat from the outside, and the second surface takes care of the rest. These bottles are the best known to preserve a liquid at a given temperature. Liquid air has been kept for a longer time in them than in any other way There is no special literature upon the subject 2. Kindly inform us if you know of any late literature published on the subject of water purification by means of ozone. A. You will find valuable papers upon ozone in the Scientific American, Vol. 107, No. 7, and Vol 109, No 1, also in the Supplement, Nos. 1832, 1895 and 1978, price ten cents each.

(12943) F. D. D. asks: This city is 5 hours, 42 minutes 40 seconds slow of Greenwich, therefore when it is noon at Greenwich it is 6 hours, 17 minutes, 20 seconds A. M. here. January 21st the sidereal time of mean noon at Greenwich is 20 hours, 0 minutes, 1 35 seconds. If at just 6 hours, 17 minutes, 20 seconds here I set my sidereal clock at 20 hours, 0 minutes, 1.35 seconds, will not that be the correct sidereal time at that moment here? It seems to me that it is correct, and a very easy way to set a sidereal clock, provided one is sure of his longitude A. If the difference of longitude is accurately known between your place and Greenwich, and you have the sidereal time of mean noon at Greenwich, you can set a sidereal clock to the sidereal time of your place as closely as the clock will allow You could not set the clock to the hundredth of a second. No clock can be set with that degree of accuracy.

(12944) A. J. R. asks: 1. Is it possible for ice to vary in temperature or density? A. Ice acts toward heat just like any other solid Raise it to its melting point and it turns to water, just as lead and tin melt when they are raised to their melting points. Cool it and it becomes colder just as any other stone or mineral will do If it is cooled it contracts and becomes denser, just as a piece of copper will do. A piece of ice lying in the open air when the thermometer stands at zero will itself be at zero in temperature. 2. Would there be any difference in the temperature of two cakes of ice brought to New York during weather never above 32 deg., one cake cut in the Hudson Bay country, the other in the Hudson River? Would one cake melt faster than the other if the weather got above 32 deg? A. If two cakes of ice were brought to New York from any great distance, when they reached this city they would both become of the temperature which the thermometer here indicates, the temperature of the air in New York. If one of these cakes had fewer air bubbles in it than the other, that cake might melt slower than the one which contained more air, but the difference would be due to the ice, not to the temperature. 3. Would a thermometer placed in the center of an iceberg indicate a greater degree of cold than if placed near the surface? A. Ice in contact with air or water which is warmer than 32 deg Fahr. will be at 32 deg., the melting point of ice. It cannot be made hotter than 32 degrees without turning to water. So long as it is ice it is not hotter than 32 deg. Fahr., no matter what it is in contact with. An iceberg floating in water will be at 32 degrees if the water is not colder than 32 degrees, since the ice is fresh and not salt. 4. Assuming a deep river or lake to be frozen to a depth of 32 inches, with the weather at zero, would the ice have a gradually higher temperature of one degree to the inch from 0 degree at the surface to 32 degrees at the bottom? A. Ice 32 inches thick, when the air on the top is at 0 degree and the water below is at 32 degrees, will change its temperature from top to bottom about 1 degree per inch, as you state. 5. If the weather remained at exactly 32 degrees all winter, would the ice in a pond increase in thickness from day to day, or would only a thin coat of ice form on the surface? A. Ice could not become very thick if the air above did not become colder than 32 degrees at any time. 6. Can a cake of ice—without melting—lower the temperature of an article placed on top of or adjacent to it? A. Ice cannot cool anything without melting, excepting the ice is colder than 32 degrees and the article in contact with the ice is already as cold as 32 degrees. Ice at 32 degrees in contact with an article which is above 32 degrees cannot cool that article without itself melting An ice box in Summer is not itself cooled by the ice unless the ice melts.

(12945) O. W. F. asks: I would like to know why telephone wires do not sing alike when the wind blows and when it does not Sometimes they make quite a great deal of racket when the wind is not blowing, and again they do not make any. A. A wire strung through the air sings, or gives a musical sound, when the wind blows over it, and the friction of the air sets the wire into vibration in the same manner in which a violin string is vibrated by the friction of the bow It is not necessary that the wind should be blowing hard for this effect to be produced, indeed, the tones are softer when a gentle breeze draws over the wires Nor is it necessary that the sound should be produced at the place where it is heard It may be quite a distance away where the breeze is rubbing over the wires, since sound is carried with a high velocity over metals We think this sound is always due to the friction of the air across the wires. The action is like that of the Æolian harp.

(12946) H. D. asks: I wish to know the exact effect of centrifugal force in connection with the ocean tides which rise on the side of the earth opposite from the moon I find no reference to this subject in popular astronomies or in the textbooks I have seen As the center of gravity between earth and moon lies some 3,000 miles below the earth's surface, it follows that about 5,000 miles is the radius of a circle described by an imaginary point on the earth's surface every lunar month It also follows that every part of the sea is more or less affected by the centrifugal force resulting from this slow revolution and affected by it every day. Is not the opposite tide to a large extent the result of this force? What books treat of the matter? A We have never seen any calculations of the centrifugal force developed in the rotation of the side of the earth opposite the moon and its effect upon the waters of the ocean in the tide on that side of the earth It can be but slight The tide on the side opposite the moon is due to the fact that the attraction of the moon on the solid earth is greater than the attraction upon the water on that side of the earth The center of gravity of the earth is about 60 radii of the earth from the moon, while the water of the remote side is 61 radii distant from the moon The attraction upon the solid earth, as compared with that upon the water, is therefore $\left(\frac{61}{60}\right)^2$ which is 1 033 + Thus the attraction upon the earth is about 3 3 per cent less than it is upon the remote water. A similar calculation for the side of the earth toward the moon gives a result that the tide-raising force on the side toward the moon is about 3 4 per cent of gravity. Centrifugal force plays its part in the formation of the tides, but it is not the larger factor in the problem.

(12947) C. S. C. asks: Do you know of any metal or substance of any kind that the lines, magnetic lines, from a permanent magnet will not penetrate? Some material, if a permanent magnet is placed under it and iron filings above, that the filings will not be attracted A. There is no material known through which lines of magnetic force will not pass. The only way in which a magnet can be screened is to place it in an iron box. The iron affords a much easier path for the magnetic lines so that they do not emerge into the air on the inside This forms what is called a magnetic screen.

(12948) R. A. D. asks: I note your reply to Query 12893 on January 3d, 1914. May I ask whether there is no more modern theory of the behavior of gaseous molecules than that of their being perfectly elastic bodies which collide and rebound without loss of energy by virtue of this property of perfect elasticity? If the pressure that a gas exerts upon the walls of a containing vessel is due to the velocity of the mass of the molecule, as in the case of a sensible missile, why is not the velocity of the molecule lessened with each impact, and consequently the pressure, even though the temperature remains constant? Briefly, is not the hypothesis of perfect elasticity merely a convenient cover for our ignorance of the specific nature of the phenomena in question? Is there accessible any coherent speculation on the subject? A. The well-nigh universal acceptance of the theory of perfect elasticity of gas molecules is the basis for our statement in Query 12893, which you question. Since your letter was received we have gone through the latest works by the best authors on this subject and find our statement in varying terms in them all Gas pressure is regarded as simply the beating of the molecules against the walls of the vessel and each other One states it that the molecules rebound with "undiminished velocity," which is just the same as saying that they possess perfect elasticity Another says, "This theory is held because it enables all the laws of gases to be readily explained" There is no disagreement among physicists on this point So we are not able to refer you to any "coherent speculation" about the matter.

(12949) O. O. B. asks: In Millikan & Gale's "Physics" there is the following experiment under the topic "Heat of Fusion" In a mixture of salt water pour snow or cracked ice and stir vigorously until the temperature reaches a point 10 or 12 degrees below zero Cent. Then into this place a test tube containing pure water and a thermometer Note that the temperature of the water in the test tube will fall as much as 10 or 12 degrees below zero Cent and not freeze, but as soon as you drop into the test tube a small piece of ice or stir the thermometer, the temperature will fall to zero Cent. and will remain there until the water is all frozen. Please explain why the water in the test tube does not begin to freeze as soon as it gets to zero Cent Is it because water will not freeze at zero Cent provided it is kept perfectly still? A The experiment which you describe is one which illustrates "undercooling" A liquid which has a definite freezing point can be cooled several degrees below that point without freezing if it is kept still so that there is no jarring or motion of the liquid, or if it is covered with a layer of oil But if it be jarred or a shock be given to it by dropping a crystal of the same substance into the liquid, it will crystallize at once. Sodium sulphate dissolved by heat is often used for the experiment, although water will answer very well. The undercooled liquid is in unstable equilibrium, and the molecular attractions are equal in all directions, but when the liquid is stirred the equilibrium is upset, and the molecules then jump into their places in the solid form which their temperature requires

(12950) J. W. McC. asks: I am anxious to get in touch with some schools that have divided, or rather segregated, the boys and girls in the physics work We are doing the work on this line this year, but have not been able to find a suitable text for the girls This is what I am after Any information will be appreciated A We do not know any schools in which the girls are taught physics in classes separated from the boys. Physics is usually taught as a branch of mathematics in high schools and most colleges, and the subject is divested of most of its interest for young people for this reason A textbook based upon the experiment and not upon the formula is much to be desired One appeared this year which is very attractively gotten up by Millikan & Gale, which we send for $1 40 postpaid It is called "A First Course in Physics," and is almost wholly descriptive No similar college textbook has appeared

(12951) T. A. B. asks. I had a question asked me as to what was in a thermometer I said that mercury and alcohol were used but some said that quinine and some other liquid were in them I would like to have you tell me what is used in them A. The liquids used for filling thermometers are mercury and alcohol Sometimes the alcohol is colored red with a dye. Quinine is not a liquid, but is dissolved in water, and water cannot be used for a thermometer in any place where it would freeze, for the reason that it expands when it freezes and bursts the vessel Alcohol does not freeze till it is cooled 200 deg Fahr below zero, and the lowest temperature on the earth is not 100 degrees below zero Hence alcohol is used in all places where the temperature falls below —40 degrees, at which point mercury freezes Mercury may freeze in a thermometer without breaking it, since mercury contracts on freezing But it will not indicate temperature correctly after freezing because it contracts differently in the solid from what it does in the liquid condition

(12952) If the correspondent from Fairmont, W Va., will give us his name, we will be glad to give him the information asked for It is impossible for us to reply to unsigned communications

(12953) If H. T. will send his name and address we will gladly answer his question But no attention can be paid to unsigned queries In this case the answer would be by mail, since the answer has no interest excepting for himself

(12954) J T. P. asks. Being a reader of your paper, and noting that you maintain a column in which you answer questions pertaining to scientific matters, I should like to know if you can give me a formula that will enable me to soften printer's ink What I wish this information for is, to transfer printed pictures to paper, cardboard, etc. Perhaps you can tell me some method by which I can do this work. My biggest trouble seems to be in finding a solvent that will not destroy the colors in the print. I would also like to get a formula for sensitizing paper, etc., such as is used in photography. I have the blue-print formula, but am in need of something that will give me a black and white, or a brown and white print I understand that you publish a book of formulas, etc. I will be pleased to learn the price, etc I consider Notes and Queries worth the price of Scientific American alone I have received some valuable hints therein A. A method of transferring newspaper pictures is given in our "Scientific American Cyclopedia of Formulas" price $5, as follows. In 1 pint of hot water dissolve 1½ drams of common yellow soap, and when nearly cold add 3¼ fluid ounces of spirits of turpentine Shake the mixture thoroughly. Apply this fluid liberally to the surface of the print with a sponge or soft brush, being careful not to smear the ink which soon becomes soft Then dampen well the plain paper upon which the transfer is to be made, and apply it smoothly to the print with moderate pressure for about one minute On separating them a reversed copy of the print will be found upon the paper The Cyclopedia contains many other processes for transferring Information on the subject will also be found in our Supplement Nos 1122, 1141 and 1094, price 10 cents each mailed

(12955) F. Z. asks Wanting to use old negatives, is there some cold-water formula for removing the film from the glass that is non-injurious to the hands? A There is no efficient cold-water method for dissolving gelatine film from old negatives Boiling them in water will dissolve the film, but the best way to get it off is by soaking in strong nitric acid This can be done without injury to the hands Handle the plates with thin slips of wood sharpened to an edge, which nitric acid does not readily affect The glasses can be taken out of the acid with these pieces of wood and dropped into water to wash off the acid The next wash should be of potash, and then a final bath in hot water will complete the cleaning For the wooden slips we use pieces of cigar boxes

(12956) F. A. L. asks: During a discussion of the relative merits of gas and electricity for heating, a very heated argument arose as to the scientific reason, or I might say the theoretical reason, of the non-luminosity of a Bunsen flame. It was agreed to submit the question to you for explanation, as all of us are readers of your valuable paper Your decision will settle a much-vexed question A The low luminosity of a Bunsen flame is due to the more complete combustion of the gas in the flame by the oxygen of the air which is mixed with the gas before it comes to the flame and is ignited In an ordinary flat flame the air comes into contact with the gas at the base of the flame and there you will see a blue or nearly colorless flame Here the heat is sufficiently high to reduce the gas to solid carbon particles and to heat these so that they become luminous The oxygen of the air in contact with the flame above now burns the solid carbon, and changes it to carbon dioxide, after which the gas diffuses into the surrounding air. The temperature of a Bunsen flame is higher than of a luminous flame, since the combustion is more perfect and the heat is confined to a smaller area The temperature of a luminous flame is that of white heat of the solid carbon particles It is given somewhat differently by different authorities, but it may be safely taken at 2 000 deg Fahr., or perhaps at 2 200 deg Fahr The temperature of the Bunsen flame may be taken at about 2,000 deg Fahr This is the figure of Prof Vivian Lewes, as quoted in Ganot

(12957) B. asks 1 Can you tell me whether the relation between heat, light and sound is such that if a metal bar were set in vibration and the vibration frequencies gradually increased, sound, heat and light would be produced in turn? A The mode of vibration in sound is that the material which is in vibration moves backward and forward in the same direction as the wave is moving The motion of the vibrations in heat and light are across the direction in which the wave is moving A sound wave cannot affect the eye nor can heat and light waves affect the ear 2 Are not light waves shorter than heat waves, and in heat are the waves shorter in higher temperatures? A Heat and light are the same in kind, only differing in degree In the light spectrum, the longest waves which are visible to the eye are three hundred ten-millionths of an inch long, and the shortest are one hundred and fifty-six ten-millionths of an inch long Heat waves extend through the greater part of the light spectrum, and far below it, thus having a greater range Within the range which the eye can perceive, if a train of waves enters the eye we see by means of it but if it struck the skin we should feel heat and not light The same waves affect the person differently according to the nerve they impinge upon If they strike the optic nerve they are transformed into light, if they strike a nerve which can feel heat they are perceived as heat Light waves are longest in the red of the spectrum and shortest in the violet Heat waves extend below the red for a long distance, increasing in length downward below the red heat The higher temperatures have the shorter waves 3 Mathematically there would be no vacuum created in a Torricellian tube if the tube were 50 centimeters in length Is that correct? A The vacuum in a Torricellian tube is formed when the tube is so long that the pressure of the air is not able to support the mercury to the top of it At the sea level and in good weather the mercury will be held up to 30 inches, or 76 centimeters. If the tube is shorter than that the mercury will be held up to the top if longer the mercury will not fill the tube and the space above the mercury is called a Torricellian vacuum. It contains vapor of mercury.

NEW BOOKS, ETC.

WAR TIME IN MANILA. By Rear-Admiral Bradley A Fiske, U.S N., of the U S S "Petrel" and "Monadnock" during the War. 275 pp, numerous half-tone illustrations. Boston: Richard G. Badger, The Gorham Press.

It is many years since Dewey sailed into Manila Bay and fought the memorable action with the Spanish fleet, but it is not so long ago that the more intimate incidents of that action and of the events succeeding as told by a personal eyewitness fail to have a fascinating interest for the reader Much has been written about the naval and military campaign in the Philippine Islands, but we doubt if any work has appeared which carries such a personal and intimate touch as the simply and very graphically written account contained in this volume

Many people have wondered how the fighting man feels in the moments preceding his entry into battle and this volume gives us here and there an illuminating insight to the psychological side of this interesting question as note the following describing the night hours immediately preceding the battle of Manila Bay

"I found the wardroom absolutely dark Then I felt my way to my own room and lay down on my bunk The deck above my head was distant about two feet and I thought how very flat I would be squashed out against that deck if a torpedo exploded under the ship" Fiske's position during the engagement was probably one of the best points of vantage from which to view the battle with Admiral Montojo s little fleet of gunboats Says he "There was not even a conning tower on the 'Petrel,' so I had rigged up a platform on the foremast about forty-five feet up, where I could sit with my stadimeter above smoke and measure the range of the enemy and inform the captain of whatever important incidents or movements my clearer view might enable me to see" Says the writer About the decks of the 'Petrel' things were entirely different from what I had expected I had seen many pictures of battles and expected great excitement I did not see any excitement whatever The men seemed to me to be laboring under an intense strain and to be keyed up to the highest pitch, but to be quiet and under complete self-control, and to be doing the work of handling the guns and ammunition with that mechanical precision which is the result we all hope to get from drill Admiral Fiske criticises the Spaniards for not putting their fleet under the batteries of Manila, where four powerful modern 9 2-inch guns were mounted, guns which if properly handled, could have sunk the whole of the American fleet "Any one of these guns would have sunk our vessel or disabled the other ships" The work deals in the most interesting and illuminating way not merely with the sea-fight itself but with the operations, naval and military, which followed Dewey's victory Anyone who wishes to get an intimate view of naval life as seen from the standpoint of an unusually intelligent and observant naval officer who has the gift of looking below the surface of things and analyzing what he sees with a philosophical mind will do well to purchase this most interesting work

MACHINERY'S HANDBOOK. For Machine Shop and Draughting Room. A Reference Book on Machine Design and Shop Practice for the Mechanical Engineer, Toolmaker and Machinist New York The Industrial Press, 1914 12mo, 1400 pp, illustrated. Price, $5

Machinery has put out a reference book that is good to the eye and helpful to the hand It embodies the best of a twenty years' accumulation of material with gleanings of important data from hundreds of sources The work collects and systematizes the established principles and practice in the design construction and operation of machinery There are tables - mathematical, logarithmic and trigonometrical, data dealing with strength of materials, with gages with keys and keyways with shafting and with gearing, formulæ for springs, block brakes rope drums and riveted joints This is but mere random mention It would be hard indeed to find any essential phase of machine design or construction that has been overlooked or slighted The pages are lavish of diagram and clear as to meaning Among operations may be cited grinding polishing, broaching, testing for hardness die-casting, forging welding and etching This list will convey some idea of the versatility of treatment The primary principles of geometry, and of mechanics, are concisely set forth the properties of air, water and heat are considered, there is a digest of the patent regulations and an index which is the open sesame to the treasure of the volume The work easily takes the place of many smaller and less authoritative books that cumber the shelf of the mechanical engineer, the draughtsman and the machinist

ARTIFICIAL PARTHENOGENESIS AND FERTILIZATION By Jacques Loeb, Member of the Rockefeller Institute for Medical Research. Originally translated from the German by W. O Rodman King, B A. Chicago: The University of Chicago Press, 1913. 8vo.; 312 pp. Price, $2.50 net. Postage, 18 cents.

This is an enlargement of the work that in 1909 set the world talking—a description of the experiments that led the press to announce that the artificial production of life was an accomplished fact The actual extent of the achievement is of course, the artificial fertilization of the egg, dispensing with the assistance of the spermatozoon; and in using these physico-chemical agencies the result is limited to fertilization and maturation, the hereditary features usually conveyed by the male cell naturally being absent This, however is glory enough for the time being It is but the absorbing preface to what is practically a new science Loeb's first two chapters set forth the present status of this science in language readily understood by any educated person The behavior of the egg under the chemical stimulant is closely observed, and deductions as to its changes under the influence of the spermatozoon are interestingly drawn A suggestion laymen are to-day closely following the development even of abstruse and specialized science, subjects that were yesterday closed to popular discussion are to-day topics of general conversation Why do not scientists more generally include in their works a glossary of the terms used? This would add greatly to the satisfaction of the general reader, promote the sale of such works, and forward the cause of education

HARPER'S BEGINNING ELECTRICITY. By Don Cameron Shafer. New York: Harper & Brothers, 1913. 8vo.; 275 pp.; fully illustrated. Price, $1 net.

HARPER'S WIRELESS BOOK. How to Use Wireless Electricity in Telegraphing, Telephoning, and the Transmission of Power. By A. Hyatt Verrill. New York Harper & Brothers, 1913. 8vo; 185 pp.; fully illustrated. Price, $1 net.

These two books, uniform in size, address themselves to the young student. The first forms an introduction to the general subject of electricity. Written for "the real beginner," the text shows extreme care in the selection and presentation of the various phases of a complex subject. What we know about electricity is sketched in the first chapter, from a talk on the behavior of electrical energy we pass to simple experiments in static electricity, and to galvanic action. Batteries, the electric circuit, magnetism, and their application in modern devices are but a few of the things explained. The second volume is a brightly written manual of wireless. The principles, operation, and construction of wireless transmission are lucidly set forth with the aid of lavish illustration The chapter on the establishment of a station deals with site, construction of aerials insulating and ground connections The student is wisely taught to make his own instruments—for in no other way is such a grasp of essentials obtained as by making a thing throughout

SUSPENSION BRIDGES AND CANTILEVERS. Their Economic Proportions and Limiting Spans. By D B. Steinman, C.E., Ph D New York D. Van Nostrand Company, 1913 16mo.; 185 pp. Price, 50 cents

The entrance of this little work into a second edition has given opportunity for its revision The analytical studies of the relative merits of suspension and cantilever types remain the same but there are modifications in nomenclature and definitions which allow the distinctions between theoretical and practical limits of span to be more closely drawn All alterations are in the interests of precision, the bibliographies have been extended and references to articles appearing since the publication of the first edition have been added Four folding plates illustrate the described designs

THE "WELLCOME" PHOTOGRAPHIC EXPOSURE RECORD AND DIARY. 1914. New York. Burroughs, Wellcome & Co Price, 50 cents.

The Record is a neat little snap-flap pocket-book with processes and tables, a number of blank pages are ruled for recording details of negative exposures, with space for an index. Diary and memoranda pages follow A unique feature of the book is the circular sliding scale affixed to the inside back cover, which gives the correct exposure in seconds or fractions of a second. The issue of a special United States edition is a point that will appeal to American photographers

SOLVENTS, OILS, GUMS, WAXES AND ALLIED SUBSTANCES. By Frederic S Hyde, Ph B. New York· D. Van Nostrand Company, 1913. 12mo.; 176 pp. Price, $2 net.

The factory chemist will find in this condensed reference work descriptions of the organic products of commerce, with their chemical make-up, a hint as to the process of obtaining them, and details of their appearance, qualities, and chief uses. The products are grouped under general heads such as terpene bodies, soaps, fatty acids, carbohydrates, etc Any difficulty in finding a required substance, due to ignorance of the classification under which it comes, is obviated by a full index

THE BRITISH JOURNAL PHOTOGRAPHIC ALMANAC AND PHOTOGRAPHER'S DAILY COMPANION 1914. Edited by George E. Brown, F.I.C. Fifty-third issue. New York: George Murphy, Inc. Price, paper, 50 cents; cloth, $1.

A triumph of compact corpulence, the annual comes to us this year with its usual quota of directories, formulæ and papers. Since the advertisements are responsible for more than two thirds of the volume's bulk, we may be pardoned for mentioning them first They are not only advertisements—they are divertisements—good, bad, and indifferent, but mostly good. Their photographic reproductions and the wealth of old and new apparatus they offer will hold the camera operator's attention as much as the text proper. The latter, in addition to the almanac, tables, and processes, numbers among many new features a glossary of photographical terms, with foreign equivalents; and reproductions of incorrectly exposed and developed negatives, which point their moral more effectively than pages of dry warning. The progress of the past year is summarized, and helpful hints and articles abound.

HANDBOOK ON SANITATION. A Manual of Theoretical and Practical Sanitation. By George M. Price, M.D. New York: John Wiley & Sons, Inc., 1913. 12mo.; 353 pp.; 25 illustrations. Price, $1.50 net.

This handbook, first published twelve years ago, is in its rewritten form to be unqualifiedly commended to health-inspectors and physicians. It is used as a school and college text-book, and might be very profitably studied by the general public It covers soil and sites, air, ventilation, heating, water supply, sewage disposal, and plumbing These constitute the material of the first part The second is devoted to sanitary practice, and deals with the problems of housing, of trades and occupations, and of disinfection. The third part relates to sanitary inspection as a profession and gives important information on civil service examinations, with many useful calculations and tables. The style is condensed, but practical

THE WONDERS OF WIRELESS TELEGRAPHY, Explained in Simple Terms for the Non-Technical Reader. By J. A. Fleming, M A, D Sc., F R S New York: E. S. Gorham, 1913. 12mo.; 279 pp.; illustrated. Price, $1.40.

The plethora of cheap works on wireless telegraphy, addressed to non-technical readers, bears witness to the wide-spread interest in this means of communication Our author condemns many of the popular handbooks on this subject as giving "insufficient explanations of the physical processes involved" The general reader will find this work dealing at greater length and detail with the phases of radiotelegraphy than do the cheap books to which objection is made It presents theories of the ether, electricity, and electrons, gives the known facts of electric oscillations and waves, describes wireless apparatus and its operation fully, and refers to wireless telephony and the utilization of electromagnetic waves Pictorial illustrations are not spared wherever their inclusion is necessary to a quick grasp of principles.

MECHANICS FOR BUILDERS. Part I. By Edward L. Bates and Frederick Charlesworth. Longmans, Green & Co., 1913. 12mo.; 201 pp, with diagrams. Price, $1 net.

Students of building construction who desire to perfect themselves in the principles of form and design are generally required to wade through the whole subject of applied mechanics This textbook selects from the larger study such subjects as bear directly upon building problems. Volume 1 presents a first-year course of great flexibility, in which is given a thorough grounding in strength of materials and theory of structure

PRACTICAL HAND BOOK OF GAS, OIL, AND STEAM ENGINES. Stationary, Marine, Traction. By John B. Rathbun. Chicago: Charles C. Thompson Company, 1913. 8vo, 370 pp.; illustrated. Price, silk cloth, $1; flexible leather, $1.50.

The work exhibits a thorough knowledge and an ability to so express the knowledge as to make it available for the layman It deals with the construction, operation, and repair of all kinds of engines, with the various parts in detail, and with the different kinds of fuel.

THE AUTOMOBILE BLUE BOOK. 1913. Volume II. New England and Maritime Provinces. New York: The Automobile Blue Book Publishing Company. Cloth; 5¼ x 9⅜ inches; 1100 pp.; with several maps. Price, $2.50

This handy guide, or touring handbook, hardly needs an introduction Covering the motor routes of the New England section and the Atlantic Provinces of Canada, with connecting extensions into adjoining states and provinces, with the care, detail and completeness that have characterize this work in the past the book should most certainly be included as part of the equipment of all autoists The sections have been systematically arranged for the convenience of the user and the routes shown in graphic detail on the large index map At the beginning of each route the principal points of interest along the way are outlined Coupled with this, is a complete and comprehensive index covering over 20 pages, that makes the matter of locating a city or town a very simple thing

BEYOND THE ATOM By John Cox, M.A. Cambridge· At the University Press. New York. G. P. Putnam's Sons, 1913.

Here we have a popular account of the new theories of matter written by a man who has been associated with Prof Rutherford, and has therefore been privileged to witness at close quarters and discuss from day to day discoveries which have radically changed scientific conceptions within the last decade Mr Cox begins by introducing us to the atom in the seventies, but before contrasting it with the new atom, he discloses the mechanism whereby the new atom was discovered and its phenomena studied Hence we find chapters on the vacuum tube, the new rays, the new substances, disintegration, the objective reality of molecules, before the new conception of matter is really presented. The book may be strongly recommended as a trustworthy and simple presentation of one of the most wonderful series of investigations to be found in the whole history of science.

PRACTICAL PATTERN MAKING. By F. W. Garros. Second edition, revised and enlarged. New York: The Norman W. Henley Publishing Company, 1913. Price, $2.

This is the second edition of a very useful book written by a pattern-maker of thirty years experience. He describes not merely the principles of pattern making, but also the materials and tools required in this most important art. A valuable portion of the book is to be found in the illustrated examples of pattern work in wood, of metal pattern work and plate work, vibrator and stripping plates Specific instructions for plaster work are also given.

A SURVEY OF THE WOMAN PROBLEM. By Rosa Mayreder. New York: George H. Doran & Co., 1913.

Rosa Mayreder's book attracted widespread attention throughout the German Empire soon after its appearance Written by a forceful woman in a forceful style, it is here presented to the reader in an excellent translation by Mr. Herman Scheffauer. The woman problem is considered from the economic, social and ethical-psychological standpoint. It must be confessed that the author makes the most of the present rather confused status of sex psychology. She places in sharp contrast the diametrically opposed views on the intellectual and emotional capacity of woman uttered by the most distinguished men in history —a very effective weapon She takes rather too seriously, however, the utterances of Lombroso and Weininger and similar men whose scientific pretensions have long since been riddled. In these days of feminism, equal suffrage and the general movement on behalf of women, a book such as that of Rosa Mayreder should be welcomed. It is polemic, but eminently sane.

DIE WASSERDRACHEN. Ein Beitrag zur baulichen Entwicklung der Flugmaschine von Joseph Hofmann, Preussischer Regierungsbaumeister und Kaiserlicher Regierungsrat a D. in Genf. (Luftfahrtzeugbau und -Führung, Bd. XIV.) VI und 82 Seiten 8°. Mit 57 Abbildungen im Text und 2 Tafeln. Munich: Oldenbourg, 1913.

In this book Mr. Hofmann, one of the pioneers in aerial navigation in Germany, discusses the problems of the hydro-aeroplane in a way that will be appreciated at its true worth by the student of heavier-than-air flight While the discussion is essentially mathematical, the mathematics are of a simple algebraic kind that anyone who has passed through a high school can easily understand The book is by far the best treatise on the designing and flying of a hydro-aeroplane under various conditions that we have thus far seen. It constitutes one of the series of excellent handbooks on aerial navigation edited by Capt Neumann

LEITFADEN DER DRAHTLOSEN TELEGRAPHIE FÜR DIE LUFTFAHRT von Max Dieckmann, Privatdozent für reine und angewandte Physik an der Technischen Hochschule München. (Luftfahrtzeugbau und -Führung Bd. XIII.) X u. 214 Seiten 8° mit 150 Textabbildungen. Munich. Oldenbourg, 1913.

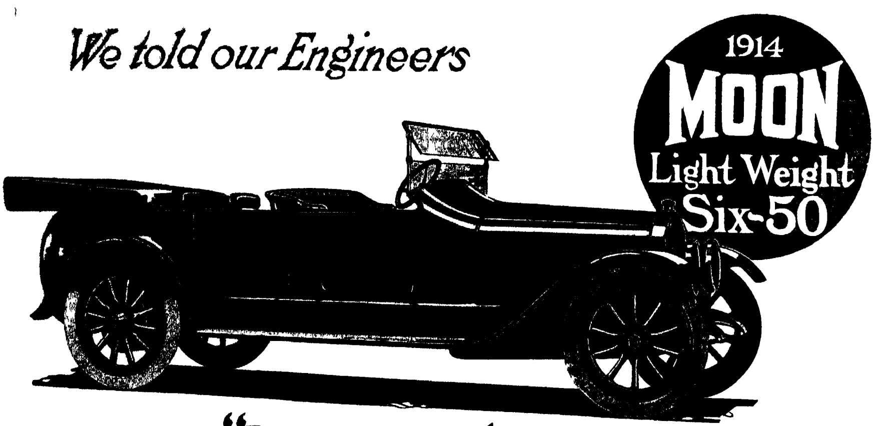
The author of a simply worded book on so highly technical a subject as wireless telegraphy finds himself in an awkward position He cannot take anything for granted, for which reason he must explain at considerable length conceptions and terms which form part of the elementary intellectual equipment of every wireless operator Accordingly, the author of this book was constrained to discuss in his introductory chapters the atomistic conception of electricity, direct currents, closed and open oscillatory circuits, radiation, etc. This he has done with rare lucidity, with the result that the following portions of his book, which deal properly with wireless telegraphy and its application to the aeroplane, should be thoroughly understandable by any educated person.

ACCOUNTING. Practice and Procedure. By Arthur Lowes Dickinson, M.A. New York: The Ronald Press Company, 1914. 8vo.; 315 pp.

Accounting is a highly important concomitant of business—particularly of big business. Yet, as the author points out, as a profession it is at a disadvantage in comparison with that of law, since its often momentous decisions are arrived at privately, and the world at large never hears of its solutions. After devoting a chapter to bookkeeping, the succeeding seven chapters take up the income account and the balance sheet. Later we consider some problems in cost accounting, and finally the responsibilities of the public accountant are dealt with. An appendix contains sections of the English laws relating to auditing, consolidation, prospectuses, etc., and the form of balance sheet statement prescribed by the Interstate Commerce Commission for steam roads. The New York form for the annual statements of life insurance companies is also given.

COAL. Its Origin, Method of Working, and Preparation for Market. By Francis H. Wilson, M. Inst. M.E. New York Isaac Pitman & Sons. 8vo.; 129 pp.; illustrated. Price, 75 cents.

We told our Engineers



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The Standard Oil Co. of N. J. has given another reorder after two years use.

The Consolidated Electric Light and Power Co. of Baltimore has just reordered 100 machines of the 1½ quart size.

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ELECTRENE COMPANY
Whitehall Building New York

Navigating Lights for the Panama Canal

(*Concluded from page 206.*)

portant light stations as the Ambrose channel to New York and the Delaware River channel to Philadelphia. As the light burns continuously, it is true that considerable gas is wasted, but the cost of the gas wasted during daylight hours is insignificant compared with the pay of an attendant; and, besides, these buoys are often placed on dangerous shoals and reefs which are unapproachable except in calm weather.

Mr. Dalen has also invented a valve used in the A. G. A. system, operated by sunlight for automatically turning the gas off during bright hours and turning it on again in fog and darkness, but so far it has not been practicable to install these sunvalves on buoys. On stationary light towers, however, they have proven a decided success. That the sunvalve is not affected by the temperature of the air is demonstrated by the fact that the Lighthouse Bureau has installed them on lights in the icy waters of northern Alaska and in the tropical seas of Hawaii and the Philippines with equal success. Its construction and operation are based upon the well-known physical law, that a dull dark surface will absorb more heat when exposed to light than one with a bright and shining surface. The Dalen sunvalve shown in section in Fig. 5 comprises a base having gas inlet and outlet passages, an upper dial plate supported by posts on the base and a disk slidable on the posts and pressed downward by a coil spring between the plate and disk, upon three outer rods mounted in the base and a central cylinder. The outer rods are of copper and have a surface of polished gold so as to reflect as much of the light as possible, while the cylinder, which is also of copper, has its surface covered with lampblack, in order that it may absorb the maximum amount of light. This cylinder at the bottom rests on a valve controlling the gas inlet, and at its top it bears against a screw in the dial plate By manipulating this screw, the sensitiveness of the device can be adjusted to any desired degree. The spring shown inside the cylinder is for varying the coefficient of expansion of the cylinder. The whole device is inclosed in a glass cylinder to protect the parts from the weather.

The operation of the device is as follows: Changes in the temperature of the air will affect the rods and the cylinder alike, for they are of the same metal, but in daylight the polished surfaces of the rods will reflect the light and hence will absorb practically no heat. Meanwhile, the blackened surface of the cylinder will enable it to readily absorb heat which will cause it to lengthen and thus force the valve down on its seat and shut off the light. When darkness or fog comes on, the cylinder and rods again assume the same temperature, and as the cylinder again shortens, the pressure on the valve plate is relieved, permitting a small spring on the end of the plate to open the valve.

On the canal, the sunvalve will be used both with the constant flame lights and also with the flasher. Fig. 6 shows a light equipped with the flasher and sunvalve. In this arrangement the sunvalve will be interposed in the gas conduit between the governor and the flashing mechanism. As in the buoy lights, a pilot flame fed by a pipe direct from the governor must be employed.

For the whole canal and its entrances, about fifty light buoys and about ninety beacon towers, range lights, etc., will be installed, and this should be sufficient to insure safe navigation at all times.

How the Locks of the Panama Canal are Operated

(*Concluded from page 205*)

these devices in incorrect sequence; for instance, opening a gate when the chain fender is not in position or when the valves are open, etc.

There is also an interlocking combination that is used in connection with the intermediate gates which divide the locks into short sections. This arrangement is fitted with a Yale lock and key, so that the intermediate gates can be used only

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Inquiry No 9360 Wanted the name and address of parties making pipe fittings such as ferrules, stems and bowls such as could be used in the making up of calabash pipes for smoking.

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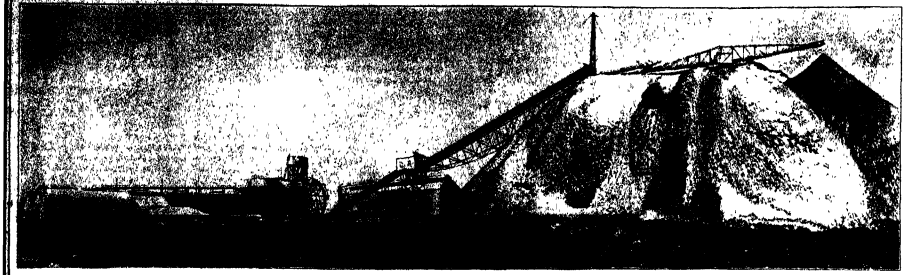

KLEINFONTEIN MINE, JOHANNESBURG, SOUTH AFRICA

This gold mill is equipped with Rubber Conveying Belts aggregating one mile in length and in constant and satisfactory operation for 12 years. There are four sorting belts 36 inches in width on 100-foot centers, and 24-inch conveyors on which the crushers discharge 260 tons of 3-inch and smaller ore every hour. The total capacity of belts in the mill is 2000 tons a day. In addition, there are waste material belts 36 inches wide, conveying waste rock, ashes, cyanide and sand to the dump pile. These discharge from one to the other and run over steel trestles, mast and boom and cantilever structures, moving 2800 tons per ten hours. Other important installations of this type of conveying belt include the Lackawanna Steel Co, Buffalo; Edison Portland Cement Co., Stewartsville N. J., Crescent Sand & Gravel Co, Port Washington, L. I.; Solvay Process Co., Syracuse, Camden Coal & Coke Co., Philadelphia, Crane Valve Co., Bridgeport; Chase Rolling Mill Co., Waterbury, and hundreds of others.

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The mining or mechanical engineer has many important problems to solve. Their accurate solutions are vital to his success.

Some of these problems are intricate and involved. In dealing with them the engineer finds that he saves time and labor, and doubly insures the accuracy of his results and the permanent utility of his work, if he calls to his aid specialists who have made a life study of some one branch or phase of engineering.

Connected with this company are members of the American Society of Mechanical Engineers and graduates of leading mechanical schools, who, in addition to their general technical training, have spent many years in the study of rubber from an engineering and scientific standpoint.

Their researches and experiments have not only resulted in the invention and improvement of various types of rubber belting, both transmission and conveying, but in the acquirement of a vast fund of specialized information which is invaluable to the mining and mechanical engineer.

This information is not a factory secret, except as to the formulae of our products. An important part of our work is educational. Members of our staff regularly prepare papers and lectures, illustrated and otherwise, for the benefit of technical schools, colleges, etc.

We are equally glad to give time and thought to the problems of the engineer. From the records of our large operations and our laboratory experiments, we can furnish many important facts and suggestions, and we are always pleased to be given the opportunity to do so.

Lamina Conveying Belt

This belt differs from other types of conveyor belt in a most important structural detail.

Its plies are laminated and independent

In a belt folded from one piece of fabric, each ply is affected by the wearing out of the first ply. Thus it often happens that when the surface wears out, the entire belt weakens and goes to pieces.

Not so with Lamina Belt. If the surface wears away and is entirely eliminated, the rest of the belt remains intact. The wear simply devolves upon the next ply, and so on, from ply to ply, abrading the belt by degrees, and thus greatly prolonging its life and usefulness.

It needs no extended argument to prove to the engineer that this type of construction is scientifically correct. It is sufficient to say that in hundreds of important installations, many of them of the most exacting nature, Lamina Conveying Belt has absolutely proved its superiority by giving a greater moving capacity and a longer endurance run, with less trouble and less repair than any other type of conveying belt in use.

Extensive conveying installations run heavily into money

In the end Lamina Belt will save a handsome percentage of that money. The proof is at your disposal

Have you undertaken the installation of a conveyor to move any kind of material, such as ore, coal, grain, phosphate, stone, cyanide, sand or cement?

If so, write us, stating the conditions and requirements fully. We can save you time and labor and help you to attain the highest degree of efficiency in the finished installation

---

Are you thoroughly informed as to the rapid strides recently made in the improvement of rubber belts and their proved superiority under all kinds of adverse conditions? Have you at hand exact, authoritative information as to the construction of rubber belts; the proper selection of duck; the correct principles of friction; the proper methods of handling and repairing; the correct manner of figuring requirements, dimensions, etc.? These, and other topics, are fully covered in a useful booklet entitled, "A Little Story of Rubber Belts." Send today for a copy of this book—it is free.

The Manhattan Rubber Mfg. Co.

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Have you a mill to belt for power?

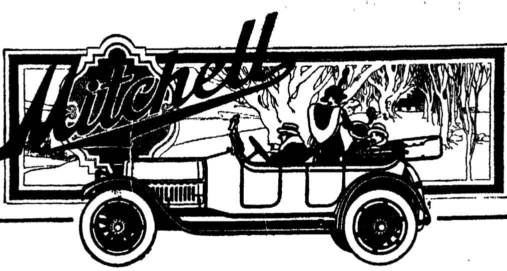
If so, you need Condor Belting It is the most expensive rubber belt made It is costly because of the labor and materials which are put into it, and economical because of the service it gives

Condor is the last word in heavy duty transmission belting In the quality and treatment of the rubber, in the selection and tests of the duck; in the scientific application of the friction, Condor stands in a class by itself

It is sold under the most sweeping guarantee ever placed behind a belt—a guarantee of more service or a new belt.

Condor is meeting with a constantly increasing and unprecedented success In mills of all kinds it sets new records in belt utility.

Let us know what your power belt problems are



Get the Personal Touch

If this particular advertisement can induce you to go to the nearest Mitchell dealer and take a ride in his demonstrator, then the object of the advertisement has been accomplished for we think the Personal Touch will sell the car

No sensible twentieth-century man will buy *anything* direct from an advertisement The real purpose of advertising is not to create a *demand* or make a *sale*, but to create *a desire to see* the article advertised.

The claims we make for this car are so many and they will sound so bombastic and egotistical in print that we haven't the heart to inflict them on you. The only way to prove the car is by *Demonstration* and the only way to make a demonstration is to get you in the car and *let you run it yourself.*

Sitting at the wheel of the *Mitchell you get the feel of the car.* You will understand after you have run the car a mile or so just what we mean by superb mechanism, ease of control, prompt response and knowledge of power You will understand without being told what we mean by sturdy build, engineering balance and proper distribution of strength and resistance to road strain. But no amount of advertising or printed matter can possibly make you understand or appreciate these features. You've got to *see* and *feel* to know

Running the Mitchell yourself you will get the *personal touch*—you will *know* just what the action is, whereas if you let someone else run it you will be accepting hearsay evidence. And we want you to know that it is a risky proceeding to invest a lot of money in an automobile on hearsay Any automobile looks good when it is running by you yet half of them will reveal coarse mechanism if you sit in the driver's seat and get the feel of the whole affair.

We welcome the personal demonstration. It leaves nothing whatever to chance It's the only way to buy an automobile and the only way to sell one If we were not absolutely sure of what the personal drive will do we would try the advertising and the hot-air plan of sale. But this car has performed so admirably for every man who has bought one that we know what it will do for you *So we don't fear the personal touch.*

Now then, if the personal demonstration pleases you—if the car performs to your satisfaction and you are sure of its action, don't buy until you ask yourself this most important question: "Will the maker of this car live up to the moral responsibility that every honest manufacturer should feel and observe? What is there behind him to prove that he will?"

The answer of the Mitchell makers is this: *"Eighty years of faithful service to the American Public*—eighty years of telling the truth—eighty years of building honest merchandise and selling it close to cost." And to confirm this we have the evidence of 30,000 Mitchell owners who love the car as we love it—who love it for what it has done and what it can do—who love it for its hourly, monthly and yearly efficiency, its lasting qualities and its economy of maintenance.

The families that created this concern eighty years ago, *own it yet.* The reputation they gained half a century ago for decency and honor remains intact today. This is your guarantee of insurance. This is the undeniable asset that goes with every Mitchell car and makes your purchase an investment rather than a speculation

No motor car is cheap. Nothing in the form of a vehicle that costs over a thousand dollars is cheap. Some cheap cars are awful cheap and some are mighty expensive whether cheap in price or not So that to get the full worth of your money and to be assured that you are not making a mistake, take the personal demonstration and ask who is behind the car that you are asked to buy.

Go to your nearest Mitchell dealer today and borrow his demonstrator for half an hour. Sit at the wheel yourself See how it feels to drive a car that has the real quality in it. If there isn't a Mitchell dealer in your neighborhood, write us direct at once and we will find a way to give you this *personal demonstration.*

Here is the Equipment for all the Mitchell Models Which is Included in the List Prices:

Electric self-starter and generator—electric lights—electric horn—electric magnetic exploring lamp—mohair top and dust cover—Tungsten valves—Jiffy quick-action side curtains—quick-action two-piece rain vision wind shield—demountable rims with one extra—speedometer—double extra tire carrier—Bair bow holders—license plate bracket—pump, jack and complete set of first class tools.

A model for every taste and requirement

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Eighty years of faithful service to the American public

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when the attendant [illegible] combination, this also being subject to the general interlocking system. Cross valves are used to cross fill between locks. These also are interlocked so that they can be operated only in proper order and combination to equalize the water between a pair of locks and save water which would otherwise be wasted. This cross filling consists in allowing water from one lock which is full to flow into a lock by its side in the other channel until the level of the water is the same in both locks, thus using a portion of the water over again.

The fact that the control board is a working miniature of the lock which it operates shows the operator the actual condition of gates, height of water, etc., and, consequently, having the whole condition in miniature under his eye he knows what to do next and when to do it; the operator receiving his information as to the movement of the vessel from a towing master.

How a Vessel is Locked Through.

Let us now take a vessel through a set of locks: It proceeds into the lock forebay either under its own power or that of a tug, and comes to a full stop. It then proceeds under the power and control of four electric locomotives—two forward to take it along, one on each side, and two others astern, one on each side, to keep the vessel in the middle of the waterway and to stop it when it has reached the proper point, and to prevent it from moving forward too rapidly.

After the vessel comes to a full stop in the forebay its position is given by the towing master to the switchboard attendant who, by moving a control switch lever, causes the lowering of the fender chain and the miniature fender chain on the control board after the lock gate is in the proper position.

Now the vessel advances into the lock by means of the electric locomotives. The fender chain is raised and then the massive gates are shut behind, the miniature control board gates in the meantime indicating this movement. When the water on opposite sides of the gates in front of the vessel has been raised or lowered, as the case may be, until the water on both sides is at the same level, as shown on the water level indicators on the control board, these gates are opened and the boat is pulled into the next compartment.

The Molecular Air Pump

(Concluded from page 208.)

second groove connects with the suction of a third groove whose pressure opening communicates with another suction opening and so on, the grooves being in series and the effect being cumulative. The pressure is lowest in the central groove and increases uniformly toward both ends of the cylinder up to the pressure produced by the rough pump. The last is connected by a rubber tube to the nozzle T which communicates with the interior of the casing B. The bearings of the shaft are oil-sealed, and the oil is prevented from penetrating into the casing by a spiral groove cut into the shaft which forces the oil outward against the atmospheric pressure whenever the shaft rotates. The spiral grooves act only when the shaft rotates with a certain speed, and it is therefore necessary in starting the pump to take care that the rough pump is not connected with the molecular pump until the latter has attained its full speed. On stopping the pump air must be admitted into it before stopping the driving motor. Fig. 5 shows the pump mounted on a common base with an electric motor of ½ horsepower which runs at 3,000 revolutions per minute. The pump is geared to the motor by a belt and runs at 8,000 to 12,000 revolutions per minute. The starting switch of the motor and the stopcock leading to the rough pump lock each other automatically so that a mistake in starting and stopping the pump cannot be made. As the new molecular pump acts directly by the motion of the molecules, it can be expected that it will remove not only the gases but also the vapors. This was shown to be the case in an [illegible] made to test the efficiency of [illegible]

[illegible] without the use of [illegible] anhydride or any other drying agent. The experiment consists in connecting to the pump a Roentgen tube of about 1 liter capacity. In about 10 seconds, starting with a pressure of 5 millimeters, the tube was evacuated to such a degree that sparks were formed in a gap of 15 centimeters connected in parallel with the tube. As a similar vacuum cannot be obtained in less than 100 seconds with the mercury pump, also designed by Dr. Gaede, it will be seen that the efficiency of the new pump is extraordinarily high. It has been found that whereas a pressure of 0.00001 millimeter of mercury is reached with Dr. Gaede's mercury pump in an average in 15 minutes, the same result is obtained with the molecular pump in 4 minutes, and this without the use of any drying agent.

Notes for Inventors

A Combination Condiment Holder.—Stanislaw I. Rocławski, of New York City, has secured a patent No. 1,070,535, for a condiment holder which includes two containers spaced slightly apart at their upper perforated ends with cut off means for controlling the discharge from their respective containers, the cut off means being connected for joint movement and having a part in the space between the container so that it can be operated by the finger of the user when the holder is grasped for use.

Life-Saving Appliance for Coal Mines.—Consul H. D. Van Sant of Dunfermline, Scotland, tells of an invention that is attracting attention among the coal miners of the Dunfermline district, being designed for the saving of lives in the event of a cage rope breaking in the mine pit. The invention includes two extra chains coming from the base of the rope and running down the side of the cage and fastening to four pieces of strong wood that project from the four bottom corners of the cage. When the weight of the cage is on these chains the wood pieces are drawn inside the framework of the cage, but when the weight is off, as when the rope breaks, the wood pieces project by means of springs and engage the bunting and bring the cage to a standstill.

Convict Ingenuity.—Convicts in close confinement and under what is regarded as very strict supervision, constantly surprise the public by the skill with which they avoid the authorities. We recall reading of a convict in the Tennessee State prison who was carrying on counterfeiting operations until the plaster-of-Paris molds were found, and it developed that he had succeeded in melting the baser metal by means of a wire connected up with the electric light wiring in his cell.

A Typewriter for Writing Bengali, an adaptation of an American machine already extensively used in India, is described in a recent consular report. The same typewriter had previously been adapted to writing seven Indian vernacular languages. The Bengali alphabet contains 360 characters, but many of these are identical with others in some of their parts. The actual number of characters engraved on the type blocks of the machine is only 92; these can be variously combined, with the aid of "dead," or non-carriage-operating keys and back-spacers, so that any letter in the alphabet can be produced. Apparently the adaptation cannot be applied to machines having a type guide, whereby the printing point is restricted within defined limits, or to shuttle or type-wheel machines.

Recording the Course of Enemy's Ship.—A patent, No. 1,084,907, has been issued to Francesco Spalazzi, a lieutenant in the Italian Royal Navy, for an apparatus for automatically and contemporaneously recording the course of the ship on which it is mounted, and of an enemy's ship. The apparatus during the travel of the ship on which it is mounted records automatically its course upon a drawing sheet or even directly on a sea chart and at the same time on the same sheet, and at the same scale it records the course of an enemy's ship, the [illegible] and position of which are thus [illegible] [illegible] and immediately

Legal Notes

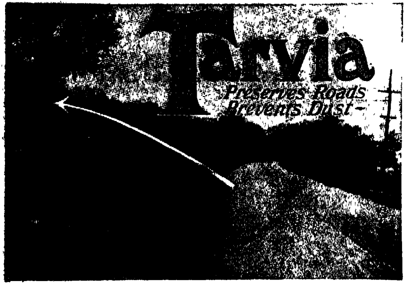
Delays in Prosecuting Patent Application.—In the case of *ex parte* Thomas wherein it was sought to revive an abandoned application, the Commissioner of Patents in granting the petition called attention to the fact that the response to the official action which the Examiner held was insufficient was filed in the Patent Office more than a month before the expiration of the year and said, "One who waits until about the last day to file a response does so at his own risk, but where the amendment is filed in ample time the applicant is entitled to some consideration."

What is Distinctive Name Writing?—In the case of Flanders & Flanders Manufacturing Company vs. Studebaker Corporation, Assistant Commissioner Frazier has held that the word "Flanders" written with a slight peculiarity in the letters with a paraph thereunder and with the upper end of the F extending in a long flourish thereover, is not written in such a distinctive and peculiar manner as to make the name registrable as a trade-mark, and quotes the decision *ex parte* C. H. Allen Company, saying "the distinctive manner in which the name is displayed must be of a character as to give such a distinctive impression to the eye of an ordinary observer as to outweigh the significance of a mere name."

Important Preliminary To Interference Declaration.—Following an order of the Commissioner of Patents, it is now proposed that preliminary to the declaration of an interference, the files of the interfering parties shall be submitted to the law clerk of the Patent Office for a final review, in order that his judgment may aid in determining whether the interference shall be declared. This is important, as it may avoid the declaration of interference in many cases where the interference should not be instituted, which cases frequently result in no benefit to either party and considerable expense to both.

Division of Re-issue Applications.—The new Commissioner of Patents, Mr. Ewing, early in his administration, indicated his intention of not blindly following precedents. In the case of *ex parte* Van Nostrand, he overruled a decision of many years standing, and held that where an application is filed for the re-issue of a patent, division cannot be required. In his decision, the Commissioner said, "the issuance of a re-issue patent is not the granting of a patent, but the exercise of the privilege of correcting a patent already granted, for which the law provides a fee different from the fee required originally, and I find no authority for requiring the applicant to pay more."

Some Adjudicated Patents.—The Colman patent No. 672,636 for a Knotting Machine has been held valid and infringed in Byrd Manufacturing Company vs. Colman; the Hall patent No. 692,277 for an Incubator as limited by the prior art and the specific language of the claim has been held not infringed in Hall, Mammoth Incubator Company vs. Teabout; the Smith patent No. 692,935 for weft-replenishing mechanism for looms, as to claims 13 and 14 has been held void for lack of patentable novelty in view of the prior Northrop patent No. 600,016, in Crompton & Knowles Loom Works vs. Stafford Co.; the Colman patent No. 755,110 for a knotting machine has been held valid and infringed in Byrd Manufacturing Company v. Colman; claims 2, 3 and 7 of the Keyes' patent No. 923,534 for an improvement in neckwear have been held void and claim 1 valid and infringed in Slip Scarf Company v. Blanchard & Price; claims 1 and 2 of the Miller patent No. 1,007,041 for a vehicle seat and lock have been held void for lack of patentable novelty and invention in Biddle v. Hodge & Graves Co. and the Coldwell & Gildard reissue patent No. 11,923 (original No. 637,234) for a warp stop motion for looms has been held void as to claim 19 as not for the same invention disclosed in the original patent and valid and infringed as to claims 23 and 25 in Coldwell-Gildard Co. v. Stafford



River Road, West Lafayette, Indiana. Constructed with "Tarvia X" Photographed two months after the flood

This road was 10 feet under water

The roadway illustrated above runs along the banks of the Wabash River at West Lafayette, Indiana.

In March, 1913, the great floods raised the river to the white mark on the tree at the left of the picture, completely submerging the macadam roadway.

This stretch of road was constructed in 1911 with "Tarvia X," and the condition of the highway after the flood gives ample demonstration of the fact that a Tarvia-bonded roadway is waterproof.

Tarviated macadam sheds an ordinary rainstorm immediately. Water does not percolate into the surface or loosen the Tarvia bond.

In this instance, the road got more than an ordinary wetting, but after the waters receded the macadam was found still in excellent condition, unchanged in contour, and ready for traffic without any attention or repairs.

"Tarvia X" is a dense, viscid, coal tar compound of great adhesive power and immune from damage by water or weather. Used as a binder, it so increases the strength of the macadam as to make it automobile-proof and erosion-proof. The saving in maintenance expense and the prolongation of the life of the road more than balance the cost of the Tarvia treatment.

Booklets on request.

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New York Chicago Philadelphia Boston St. Louis Kansas City Cleveland
Cincinnati Minneapolis Pittsburgh Seattle Birmingham
The Paterson Mfg. Co., Limited. Montreal Toronto Winnipeg Vancouver
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for Accuracy

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The Standard
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For every kind of work in the machine shop—laying out, measuring, and inspecting—there is a Starrett Tool just suited.

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Our big, new 320-page catalog No 20B describes over 2100 styles and sizes and will be sent free on request

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The L.S. Starrett Co.
The World's Greatest Toolmakers
Athol, Mass.

Unity of interest means unity of effort

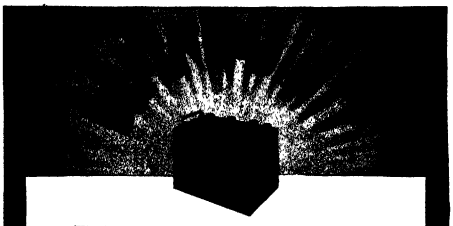
The owners, the board of directors and the executive officers of the Pierce-Arrow Motor Car Company are one and the same group of men. The

PIERCE-ARROW

organization is, and has always been, one of united individuality, one entirely free from outside interference by syndicates or any other form of external control

The Pierce-Arrow Motor Car Company builds nothing but motor cars, thinks nothing but motor cars, and all its surplus strength and energy are used to make its good motor cars better

The Pierce-Arrow Motor Car Co. of Buffalo, N. Y.



The heart, the mainstay, the vitality, the dynamic force —call it what you will—of every automobile electric self-starting and lighting device **is the storage battery.**

If that battery is not consistently powerful and unfailingly **dependable** all the skillful design and quality of the rest of the apparatus is very seriously handicapped.

The "Exide" Battery

For Auto Starting, Lighting and Ignition

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The Flying Machine and Its Equipment

A Summary of the Air Navigator's Instruments

BEFORE it really came the flying machine was popularly conceived as a sort of winged bicycle running on air, a machine that could be taken out of the shed like a buggy. But when men actually flew they soon found that flying was far more difficult than was anticipated; that, indeed, it was peculiarly like sailing a ship far from land, because the ground appears very different from an altitude than from a horse and buggy, that the motion is so bewilderingly rapid to the novice that he knows not in what direction he is flying. He must determine his whereabouts in some way and steer a definite course. The direction in which the bow of the machine is pointed has little to do with the direction of actual motion; for the machine follows not only the thrust of the propeller and the rudder, but also the direction of the wind. Again, the wind, at a height may blow in a direction quite different from that indicated by weather vanes, the swaying branches of trees, clouds of dust, fluttering flags, and the smoke from chimneys. Speed and direction of flight can be determined only by experience. Soon the knack is acquired of ascertaining how much speed is due to the motor, how much to the wind.

To steer a definite course is difficult enough even in a motor-boat. It is still more difficult in an aeroplane, requiring as it does close attention and incessant vigilance to keep the machine from capsizing. Much of this work, unfortunately, is done instinctively. After some practice, balancing an aeroplane becomes as much a matter of course and requires as little thought as balancing a bicycle. He performs the necessary motions to keep it from falling absolutely unconsciously.

But a bicycle runs on a stationary support, while the aeroplane glides on an exceedingly unsteady body of air; that is one vital difference. Another is the fact that while the balancing of an aeroplane becomes partly instinctive, still the pilot does not immediately feel whether he is losing his balance, as he would feel if he were skating or running. Sometimes he must reason Why? Because he can control it only as long as it is speeding ahead. It is very easy to stop all progress of an aeroplane in spite of the motor and propeller simply by guiding it upward too suddenly. An aviator may easily do that, and no instrument will tell him of his danger. Indeed, if an aviator wants to ascend quickly, his instincts urges him to point the nose of his machine up sharply, whereas he should do so very gently if he really wishes to climb.

In making a curve the natural instinct is to bank strongly, to incline the body toward the center of the curve. But an aeroplane banks itself the moment it is turned because of its great span. One side in turning will always describe an essentially greater circle through the air than the other, and naturally moves faster. Therefore, it rises in the air. Hence, instead of helping the banking, the pilot has often to counteract the exaggerated rising tendency of one side. It takes experience to get just the right amount. If there is too much banking the machine does exactly what a bicycle does when banked too much in turning on a wet pavement In other words, it capsizes and falls toward the center of the turning circle.

Even when control is lost by steering upward there is a parallel in bicycling. After you have pedalled a bicycle up on a steep hill with great exertion, and follow a natural but wrong instinct to relax your efforts when you have reached the level course at the summit of the incline, you are surprised to find that the bicycle has lost all its speed. It almost stops, and you have to thrust out your legs to touch the ground and prevent it from falling. With a flying machine the ground is unfortunately far off, too far off to be reached by an outstretched leg. The aeroplane should really be compared with a bicycle running high on a wire, so that if it falls it falls into space.

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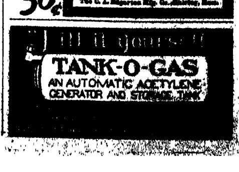
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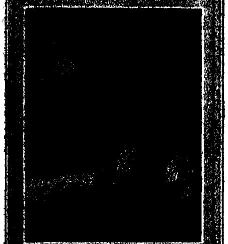

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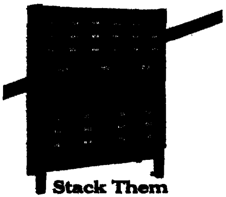

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In view of all these difficulties, successful cross-country flying is made possible only by instruments which curiously resemble those employed in navigating ships on the perilous ocean. It is obvious that a single flyer cannot make the best possible use of them. He has his hands too full. When it is remembered that a whole staff of navigation officers watch the nautical instruments aboard a ship, we realize how much is expected of the aviator. The navigating problems of the air so greatly exceed those of the water in difficulty that only dirigibles which can carry a whole staff of navigating officers are equal to the task. It becomes evident what an overwhelming advantage the two and three-seated aeroplanes have over the one-seated aeroplane.

The first instrument needed, an instrument never absent in an aeroplane, not even in the school machines that fly only above aviation fields, is a revolution counter for the motor. This is the same as that used on automobiles, and consists of a flexible shaft connected with the motor, a casing containing clockwork and a dial on which a hand travels over figures. Thus the number of revolutions made per minute is indicated. The aeroplanist cannot know how strong is the wind at the level at which he is flying; but the revolution counter sufficiently indicates what speed the machine itself is making to allow him to estimate the proper direction to head his machine.

The same service is performed, but more efficiently by another instrument with which many machines are now equipped, namely, a wind gage that measures directly the actual speed of the machine in the wind. This instrument renders another most valuable service: it shows the pilot when he is losing speed, and with the speed, the control of the machine. Formerly pilots used to depend for this information on the feeling of the wind as it struck their faces.

Similar benefits are derived from two incilnometers—levels that tell the pilot just how much he has inclined his machine fore and aft or from side to side It has been found that even a trained eye may be deceived about the actual position assumed; that in darkness the pilot loses all judgment, although he may be occasionally guided right in the dark by blind instinct. Unfortunately a fluid level, an air bubble or a pendulum device is subject to many disturbances aboard an aeroplane because of the inertia and momentum of the moving masses. Pilots will eagerly adopt a trustworthy gyroscopic indicator that will fulfill the difficult task of indicating the true horizonal Once such an instrument is invented flying will become fifty per cent safer, and will be possible even in the dark.

The control of the motor itself requires many instruments. If the aviator is alone, it may indicate only when trouble is coming, and when he should prepare himself for a downward glide, assuming that the faulty motor has not yet lost him his speed and control. If he is not alone his companion should be able to remedy the irregularities indicated by the instruments. As yet designers have given much attention to mounting the motor within easy reach of one of the passengers.

There is not the inevitable steam gage—because the engine is a gasoline motor—but a dial on which the proper circulation of the cooling water is indicated. Another dial shows the working of the lubrication system. There is a switch for throwing in or cutting out the electric ignition. Some machines have also an electric meter showing the strength of the electric current that makes the spark, and guaranteeing, therefore, that the spark is efficient. And there is a pressure gage in every machine that indicates the amount of air pressure in the gasoline tank by which the fuel is forced to the motor.

Most important is, of course, a float or a glass fluid level that shows how much gasoline is in the fuel tanks; without it the motors might suddenly cease to work over a locality where even by a long glide from a great elevation, the pilot could not reach a safe landing place.

High flyers have discovered why birds are so warmly covered with down and

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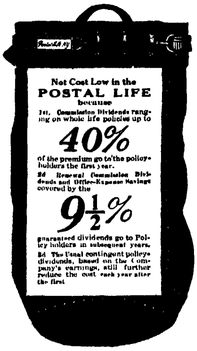
The Postal Life is one of these: they are all subject to the same **strict supervision,** and their policyholders are protected by the same **legal and governmental safeguards.**

The Postal differs from others chiefly because it **does not employ agents**; it does business **direct** and gives its policyholders the **benefit of the commissions that other companies pay their agents.**



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If you want to find out fully about the Postal Life, **don't take the word of an agent of some other company**; he is naturally prejudiced, and besides that, he is bent on influencing you his way so as to get a commission

And don't depend on what such an agent may show you in some insurance periodical which he carries about in his pocket: the article was printed for the special benefit of agents and **not for your benefit.**

Write to the Company itself for **official information,** including its Financial Statement for 1914, with a facsimile **Certificate of Valuation of the Insurance Department of the State of New York.**

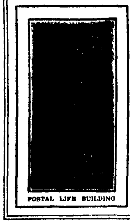
Furthermore, as the Postal Life does not establish itself in the various States, it is **not subject to taxes, licenses, and other State exactions,** which means further economy All these savings appear in **generous dividends to policyholders.**

The Company may also be able to refer you to policyholders in your immediate vicinity. It considers **satisfied policyholders its very best asset.**

ASSETS AND LIABILITIES

At the close of business, December 31st, 1913, the Company had nearly $50,000,000 of insurance in force: its policy and other liabilities were fully covered by statutory and departmental reserves amounting to $9,543,218.25, with an excess of surplus to policy holders of $230,043.93.

The Company's reserves and other assets are in approved securities, including State, municipal and railroad bonds and mortgages, real estate, policy-loans, accrued interest, deferred net premiums, cash in bank and various other items, aggregating $9,848,159.



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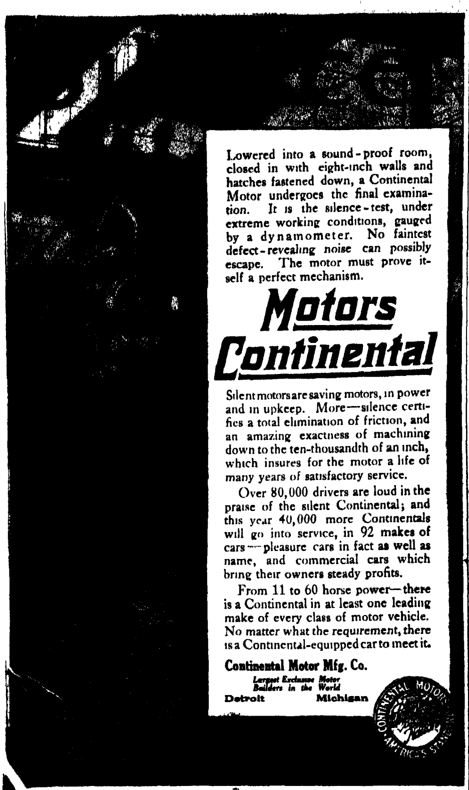

Lowered into a sound-proof room, closed in with eight-inch walls and hatches fastened down, a Continental Motor undergoes the final examination. It is the silence-test, under extreme working conditions, gauged by a dynamometer. No faintest defect-revealing noise can possibly escape. The motor must prove itself a perfect mechanism.

Motors Continental

Silent motors are saving motors, in power and in upkeep. More—silence certifies a total elimination of friction, and an amazing exactness of machining down to the ten-thousandth of an inch, which insures for the motor a life of many years of satisfactory service.

Over 80,000 drivers are loud in the praise of the silent Continental; and this year 40,000 more Continentals will go into service, in 92 makes of cars—pleasure cars in fact as well as name, and commercial cars which bring their owners steady profits.

From 11 to 60 horse power—there is a Continental in at least one leading make of every class of motor vehicle. No matter what the requirement, there is a Continental-equipped car to meet it.

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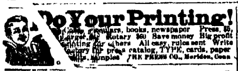

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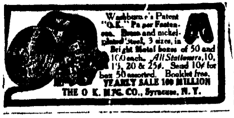

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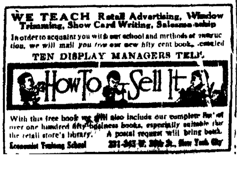

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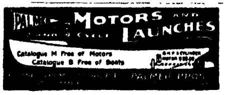

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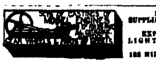

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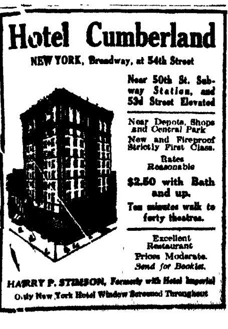

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feathers. Flying is a cold sport—as cold if not colder than ice-boating. The stinging blast of the upper air becomes unbearable to a pilot of an aeroplane. Remember he is traveling at a speed of sixty to eighty miles an hour. The warmest clothing has been tried. Still, the cold eats its way through. Pilots reach the ground numb, and apathetic, which perhaps explains some accidents that have happened at the end of long, high flights.

There is no reason why a few tubes connected with the motors should not convey the hot water from the cylinders around the pilot's cockpit. That is possible in European machines; for the barbaric method of seating the pilot in empty air at the edge of the lower plane of biplanes still compulsory in the American Wright and Curtiss machines, has been discarded abroad in favor of well protected cockpits. A heated cockpit could be provided with a windtight cloth cover that buttons to the aviator's dress like an Eskimo's "dojak."

In Austria, Etrich has seated the sorely tried pilots in a completely inclosed limousine of good stream line form, made of mica. Thus, even noxious head resistance is saved; for at sixty to eighty miles an hour, any part of an aviator's body that is exposed to the wind, wastes power.

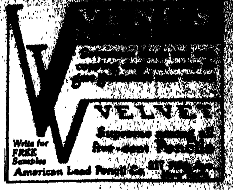
Some foreign aviators have installed in their machine a little desk on which to write notes and make little sketches. Some French machines in the last Paris show were even equipped with a little locker for food and with heating devices. Such conveniences are particularly reasonable in machines designed for two pilots with double controls so that one man may refresh himself not only with rest, but also with food and drink while the other takes his turn in guiding the machine.

A serviceable device in aeroplanes is the pilot's belt. Aviators like the oarsmen in Venetian galleys must literally be strapped to their seats. At times the wind forces the machine around with a violence that finds no parallel even in a small sailing ship in the heart of a tempest. Caught by the air the machine is hurled down so suddenly (without capsizing or getting out of control) that the inertia of the pilot's body would cause him to fly out of his seat and lose his grip on his levers unless he were held down. In fact, pilots have been pitched out of machines that were still under control and killed. It was then that the French invented the aviator's strap, a strap that holds the body fast and is still a bit elastic, a strip wide, very strong, and capable of being instantly released in case of a smash of the machine.

Flying has developed other safety devices. A life-belt against drowning does not necessarily inspire one with awe because it may be useful in learning to swim. But it is different with a safety helmet that performs its function only after you have fallen head foremost. These helmets consist of fixed padding filled with resilient, coiled, steel wire. They may save a man from a cracked skull, but not from a broken neck.

If not crowned by a helmet, aviators' costumes are usually topped by a sort of skull cap to cleave the wind with the least trouble. A weird barbaric feature of this cap or helmet is to be found in the little roll or screen at the side of the head, right in front of the ears to protect the eardrums somewhat against the terrific clatter of the motor's open exhaust. A muffler would not consume very much power. It has been tried successfully in England, and is, in fact, furnished, if desired, with the newest models of Wright biplanes. To protect the eyes from the icy blast and from flying oil, goggles are worn.

All these instruments and implements deal with the mere function of flying, of keeping afloat in space. To navigate the aeroplane, an embryonic edition of a mariner's navigating instrument is required. The compass is indispensable. Numerous difficulties, connected with its use aboard aeroplanes, have been gradually overcome. The first is the excessive vibration of a frail and small craft—an engine room as it were—with a motor



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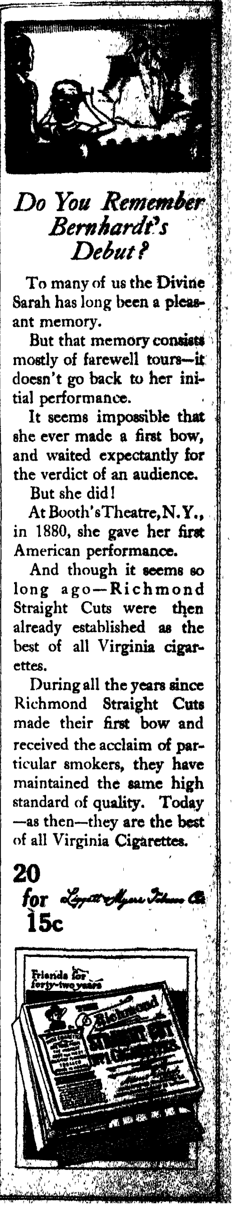

Do You Remember Bernhardt's Debut?

To many of us the Divine Sarah has long been a pleasant memory.

But that memory consists mostly of farewell tours—it doesn't go back to her initial performance.

It seems impossible that she ever made a first bow, and waited expectantly for the verdict of an audience.

But she did!

At Booth's Theatre, N. Y., in 1880, she gave her first American performance.

And though it seems so long ago—Richmond Straight Cuts were then already established as the best of all Virginia cigarettes.

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equipment of nearly one fifth the power of that of a mammoth dirigible. Aeroplane compasses are now floated in a liquid contained in a vessel that is supported on a bed of resilient felt-chips. A formidable obstacle to the use of the compass is the mass of iron in the powerful motors, necessarily in close proximity to the magnetic needle. It is no easy task on shipboard to arrange pieces of iron around the compass so that no matter how the ship may turn, and in what position the mass of its hull may be relatively to the needle, the needle will always turn to the north. An aeroplane turns not only around a vertical axis, but also around a horizontal axis when it is inclining. It turns, moreover, more suddenly than a ship. Still the aeroplane compass has been made fairly reliable.

For cross-country flying a map is as necessary as a compass. Maps for aviators are different from other maps. They must not contain too much confusing detail. For quick reading they must emphasize those features which most resemble the general outline and the principal landmarks visible on the ground. They must chart the dangers to the aerial navigator—eminences, such as church towers, factory chimneys, even high trees. All suitable landing places must appear on the map, as well as telegraph wires and high-tension conductors. Very important is the indication of the different levels of the ground. Without that a machine may easily come to grief.

Moisant employed an easy method to hold a definite course with map and compass. He simply picked out some prominent landmark, the tower of a church, for instance, in the general direction of his course, fixed his intended direction on the compass dial and noted the changing position relatively to his chosen mark. When he came too near to the latter he picked out a new one. In the recent flight from Berlin to Vienna an officer guided an aviator, whose passenger and helper he was, even above the clouds, simply by taking his direction from the sun and computing the sun's position by his watch. This presupposes an extraordinary sense of locality. Using the same principle, a compass has been constructed for aviators that is simply a sun dial reversed. As a sun dial will give the time when the points of the compass are known, this instrument, of identical construction, will give the points of the compass if the time is indicated by a perfect chronometer. Astronomical tables showing the changes of the sun's position with the seasons must be consulted. Even finding a place astronomically by taking the sun's height is now taught to German aviator officers, thanks to Prof. Marcuse, who has designed instruments with which these measures may be taken very easily and quickly, by means of an artificial horizon and tables with hardly any figuring. Such methods will be of great benefit to an aeroplane that has completely lost its way above clouds.

It is often of the greatest importance that the aviator should know his altitude above sea level. So, after nautical localizing, he should be able to read his altitude above the ground from his map, which should give ground altitude in order to be absolutely accurate. Thus the aviator is able to keep clear of the ground and its many dangers.

It is always well for the aviator to know his exact altitude. Therefore, he carries a barometer—not the old-fashioned kind with mercury in a long glass tube, but a little contrivance that indicates by clockwork on a dial the deformation of an elastic casing from which the air has been exhausted. Aeroplanes also occasionally carry barographs—the same sort of barometer, but one that automatically registers the changes of altitude during flight on a sheet of paper.

The Wireless Telegraph Station at Punta Arenas, on the Straits of Magellan, is expected to be in full operation early this year. It will be a station of 100 kilowatts, comprising seven tubular steel masts 200 feet high, and costing over $150,000. A provisional installation on two of the masts has already established

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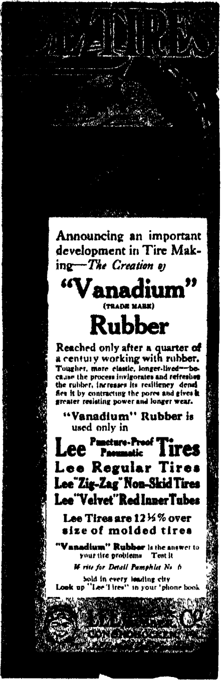

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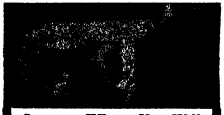

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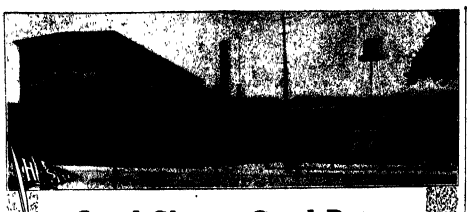

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Recent Advances in the Art of Lacquering

By L. V. Redman, Department of Industrial Chemistry, University of Kansas

THE art of lacquering metal consists in placing a thin transparent film of varnish upon the polished surfaces of metals such as silver, brass, copper or German silver, to serve as a protective coating and prevent the rapid tarnishing of these surfaces by such agents as oxygen, sulphur, acid vapors, and the active reagents in the air, e. g., coal smoke and furnace fumes. Lacquers have consisted generally of natural gums dissolved in suitable solvents to which have been added small amounts of drying, vegetable, oils; these oils serving as agents to toughen and temper the brittleness of the resins and allowing the lacquers to be applied easily and smoothly. The solvents are alcohol, amyl acetate (banana oil) wood spirits, denatured alcohol, ethyl acetate, wood distillates, nitro-benzene, benzol, petroleum spirits and turpentine. The resins, gums or waxes are kauri, gum elemi, soft copals, shellac, ceresin, casein. These resins are very largely replaced by artificial materials such as nitro-cellulose, cellulose acetates, celluloid and cellulose formate

The oils added to decrease the brittleness consist of linseed, tung oil, and castor oil. Other materials used for this purpose are camphor and glycerine. Recently, that is, within the last four years, there have appeared on the market lacquers of new order These lacquers are composed entirely of synthetic resins dissolved in the regular lacquer solvents. They contain no oils, no natural resins or gums, and in fact have no natural product of any kind whatsoever in them. The raw materials for these varnishes are very wonderful and the synthetic lacquers stand as a monument to the modern chemist's skill. They consist of carbolic acid, which is obtained from the tar that collects upon the sides of the ovens when coal is being roasted to produce illuminating gas or coke, and formaldehyde, which is produced from wood alcohol by incomplete combustion.

When carbolic acid (or phenol, the general name applied by chemists) and commercial formaldehyde, in equal volumes, are heated together for some time, there results an amber-like resin which, if not heated too long a time or at too elevated a temperature, is soluble in alcohol, amyl acetate, nitro-benzene, aniline, wood distillates, carbolic acid and many other solvents The reaction between the carbolic acid and formaldehyde may be hastened very much by the introduction into the mixture of such foreign substances as salt, washing soda, acids, alkalies, and salts generally. These foreign substances are added in small amounts and are used for the sole purpose of hastening the reaction. As their rôle is not well understood in the reaction, the chemist is satisfied to say that they act catalytically and the substances are called catalysts, meaning that the reaction is hastened by their presence, although they do not enter directly into the reaction. As the formaldehyde is volatile, the reaction is carried on in closed vessels fitted with reflux condensers, to prevent the escape of the gaseous formaldehyde After the heating has continued for the desired length of time, generally one hour, the mass is allowed to cool and the gum is taken from the vessel, washed well in water to remove the catalyzer and then dried. The result is a resin not unlike common resin in appearance and possessing many of its physical properties. The resin melts at 80 deg. to 100 deg. Cent. It is rather brittle, dissolves readily in the common solvents, except petroleum products, and when about 20 per cent by weight is dis-

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solved in 70 per cent alcohol and 10 per cent amyl acetate, it makes a lacquer which dries very rapidly to a hard lustrous coat.

The article thus coated and dried is subjected to a process of heating for different periods of time, from a few minutes to several hours, depending upon the temperature and the thickness of the coat. The temperature ranges from 125 deg. to 200 deg. Cent. The higher the temperature the more rapid is the transformation. This heating process imparts the most wonderful properties to the lacquer. After the heating it is completely insoluble in all ordinary solvents, and the lacquer may be allowed to stand in alcohol or acetone for weeks at a time without suffering the slightest depreciation. Acids and ammonia have no effect whatsoever upon it, and strong alkalies dissolve it only very slowly.

The lacquer may be applied either with an ordinary brush or air brush, or the article may be dipped in the lacquer. After coating by any of these methods the article is dry in the course of an hour and may be placed in the oven for heating. The baking is generally complete after one hour, and the article is removed from the oven and is ready for the market. Two or more coats may be given to the article if desired before the heating process is begun. Generally two coats are sufficient. Articles thus lacquered are of special value in chemical and medical laboratories to withstand the corrosive fumes of the chemicals. Microscopes, polariscopes, and instruments which are made largely of brass, copper or silver, retain their luster indefinitely when thus coated. The lacquer also has much more extensive uses in the lacquering of brass beds and brass and copper household ware, such as candle-sticks, trays, candelabra, brass urns and all kinds of beaten copper and brass.

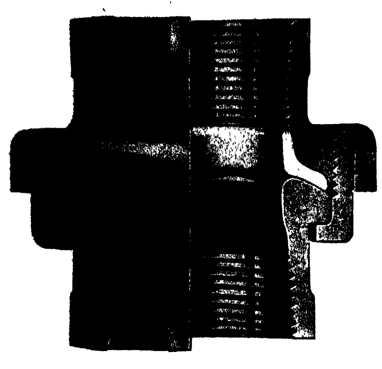
Once the article is properly coated with this lacquer its surface is immune to the attack of solvents and the atmosphere. It may be immersed in alcohol, acetone, dilute acids, alkalies, or washed with hot soap and water, without injury. Ammonia, vinegar, or other solvents likely to be found in the average home has no effect upon it. The lacquer may be injured by the use of such cleansers as contain grit in any form, as the grit actually cuts off the lacquer by erosion. In every other respect the lacquer is permanent. It possesses a durable lustrous surface, is quite transparent and elastic in thin films, and possesses a light golden color which may be made any desired color by the use of the proper dyes or pigments

Philippine Government Students in the United States

FOR a number of years the Philippine government has been sending young Filipino men and women to the United States to receive a collegiate education with a view to appointment to higher positions in the government service. Up to date 211 of these "pensionados," as they are called, have been sent over, and a large number of these have been appointed to office on graduation. Hereafter a different policy is to be followed, as the islands now have a university of their own, where natives may receive thorough training in all undergraduate subjects. Accordingly, pensionados will only be designated for postgraduate study in the United States. The Philippine legislature, at its last session, provided fifteen fellowships for advanced work at American institutions.

Explorers Using Wireless Telegraphy

THE Italian expedition to the western Himalaya and the Karakorum, under Dr. F. de Filippi, is equipped for wireless telegraphy and is preparing to use this means of determining longitude in its surveys. The outfit has been tested in India, where it was used for time signals between Simla, Delhi and Lahore, and subsequently between Skardu, in Baltistan, and Lahore.



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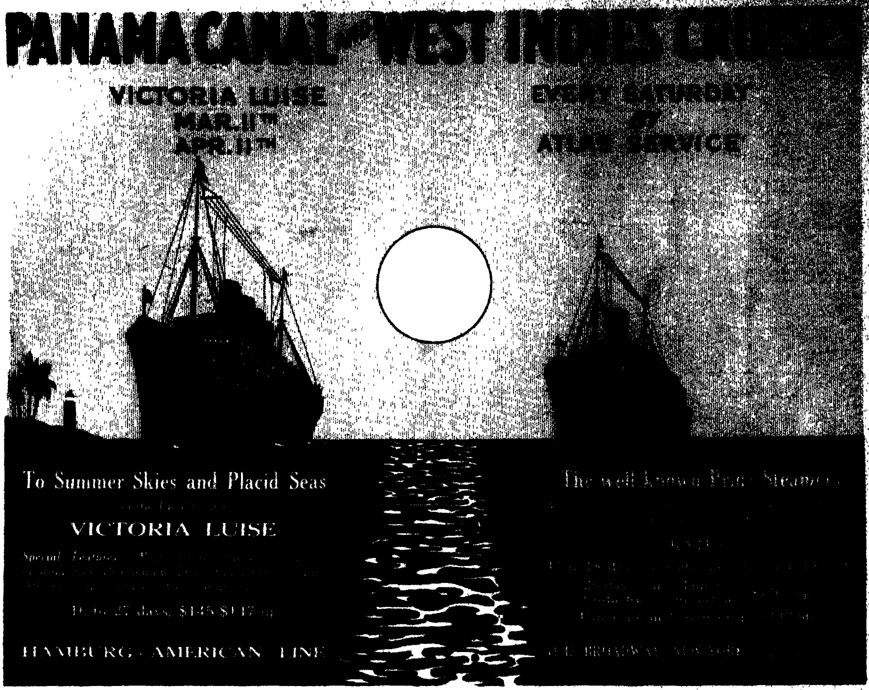

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Vol. CX. No. 11
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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Mawson and Wilkes

IN March, 1839, when the ancient belief in the existence of a great *terra australis* surrounding the south pole had been generally abandoned, an English sealer, John Balleny, had the first distant glimpse of the long coast-line south of Australia now known as Wilkes Land. Balleny did not, however, realize the significance of his discovery, and for aught he or the world knew to the contrary he had merely sighted some islands of no greater extent and importance than those which he had previously discovered farther to the east, and which now bear his name.

Early the following year two expeditions, neither of which knew anything of Balleny's discovery, sailed closer to the coast in question and sighted land at several points. One of these, under Dumont d'Urville, discovered Adélie Land and Clarie Land, but did not suspect them to be parts of a continental mainland. The other expedition, under Lieut. Charles Wilkes of the United States Navy, traced the coastline for so great a distance that the leader had no hesitation in naming it "the Antarctic Continent." If Wilkes and his companions had not been sent upon their Antarctic quest in ill-provisioned and half-rotten ships, unsuited in every way for exploring in high latitudes, it is altogether probable that the American expedition would have effected a landing somewhere along the coast, and brought back the definite and detailed information in regard to this region for which, as fate would have it, we have had to wait over seventy years.

During the rest of Wilkes's lifetime and long afterward his discoveries formed a bone of contention among geographers. As lately as 1885 Sir Clements Markham wrote in the ninth edition of the "Encyclopædia Britannica" (art. "Polar Regions"): "In 1839 the French expedition under Dumont d'Urville proceeded south from Tasmania and discovered two small islands on the Antarctic Circle named 'Terre Adélie' and 'Côte Clarie.' At the same time Commander Wilkes of the United States expedition made a cruise to the southward and mapped a large tract of land in the latitude of the Antarctic Circle for which he claimed the discovery. But as a portion of it had already been seen by Balleny, and the rest has since been proved not to exist, the claim has not been admitted."

Even in England, where skepticism regarding the American discoveries has been perpetuated as a heritage from the unfriendly counterclaims of Sir James Ross, few geographers have taken so extreme an attitude on the subject as is indicated in the above paragraph. "Wilkes Land" has appeared intermittently on British charts from at least as far back as 1850, the year in which was published the second edition of A. Keith Johnston's "Physical Atlas," which shows this land as an unbroken coast-line extending for about 1,500 miles in approximately its true position. In recent years the controversy has narrowed down to a question concerning the existence of Wilkes's last reported landfall to the west. Where the American commander thought he saw "appearances of land" to the southwest, and marked Termination Land on his chart, neither the "Challenger" nor the "Gauss" expeditions were able to find land, and the Mawson expedition has now definitely proved its non-existence. Whether Wilkes mistook ice for land, or actually saw the distant coast lifted into visibility by refraction, or—a much less probable supposition—made an error of over a hundred miles in his position, will probably remain a mystery.

On the other hand, the Mawson expedition, which has just completed its labors in the Antarctic, has removed the last vestige of doubt concerning the reality of the continental coast discovered by the American expedition three quarters of a century ago.

The Supreme Court's Pure Food Decision

WHILE the decision of the Supreme Court in the bleached flour case will probably prove a bitter disappointment to many, it was a decision that must have been expected by those who have closely followed the wrangles to which the pure food law has given rise. The Referee Board has shown beyond the shadow of a doubt (and the experiments conducted by *ex-parte* investigators in Europe and America confirm its findings) that very small quantities of injurious substances have no harmful effect.

As we understand it, the decision by no means goes so far as to hold that food which is unfit for human consumption may be treated with harmless proportions of injurious chemicals in order to make it marketable. It does however throw upon the Bureau of Chemistry the task of proving conclusively that a questionable food is so noxious that its sale should be forbidden.

In these days of the high cost of living a food manufacturer of honest intentions should not be too greatly hampered in his effort to place a wholesome product upon the market at a reasonable price. To be sure, the question of wholesomeness may give rise to a hot controversy; but it is for the very settlement of these questions that the Bureau of Chemistry and the Referee Board exist.

That the Bureau is now doing its work competently and adequately we are convinced. The bleached flour case must be regarded as a heritage from a time when the physiological findings of the Bureau were not all that could be desired, and the decision is not to be considered as a reflection upon the present personnel of the Bureau. No doubt the decision will have the effect of increasing the Bureau's work. More analysts will probably have to be engaged, and more stations for the examination of food products established. Congress has been exceedingly generous in its appropriations for the Bureau's work, and there is no reason to suppose that it will be any less liberal in the future than it has been in the past. Surely the task of guarding a whole nation's health is so important that Congress will not spare any expense in attacking it properly.

How to Help the Poor Inventor

WHAT good are laws if inventors are poor? Put money into the patentee's pocket and at once the difficulties of inventing are cleared away—so we would gather from a bill introduced by the Hon. Mr. Samuel W. Smith in the House of Representatives and ordered to be printed.

First of all a workshop is to be created "where all records, books, models, drawings, specifications, and other papers and things pertaining to inventions designed by inventors *without* means shall be safely kept and preserved." Next a commission, to be elected "by direct vote of the people," is to set the price or royalty to be paid the inventor for his invention. By *direct vote of the people*, mind you! Visions of primaries, conventions, caucuses arise. The selection of the commission assumes the importance of a presidential election. All the elaborate political mechanism of the electoral system is to be set in motion.

But the commission presumably has nothing to do with inventors who have money. Only "inventors without means" are considered. The man who can scrape together the statutory Patent Office fees is probably not "without means." Therefore the existing patent laws apply to him. Not for him is the Inventors' Workshop in which his ideas are to be worked out, not for him is that "farm of suitable size and locality," provided for by Mr. Smith, in order to try out "machines adapted for use in cultivation of the soil, and gathering its products." That unfortunate is just rich enough to escape good luck, as it were.

There are some compensations for this lack of poverty. "All inventions worked out at said Inventors' Workshop shall be the property of the United States Government." Instead of falling into the maw of some greedy trust, the poor inventor is to be devoured by his own Government, he is to be propped up with one arm and knocked over with the other.

In a section which contains only two lines, the Hon. Samuel W. Smith disposes with classic brevity of the intricate subject of infringements. "The Government shall pay for all patents and defend all law suits for infringements." The Book of Genesis is not more simply worded. Representative Oldfield of Arkansas, whose compulsory license theories have been made a target by manufacturers, must feel that he is a blind reactionary with medieval ideas when he considers this simple and highly progressive method of dealing with infringement suits with a mere wave of the hand.

The people are not forgotten in Mr. Smith's scheme. "The Government shall establish factories where inventions shall be manufactured and sold direct to the people at cost." Government ownership encroaches on a new field. Nor are the factory workers overlooked. No slave driver, no miserable sweatshop, shall profit by the poor inventors' labors. The workers are "to receive for their labor the full equivalent of their production in maximum uniform wages."

Even the interests of mankind are considered. "No invention or inventions intended to be used in the prosecution of war or destruction of human life, or for the composition of any drugs, foods, or articles injurious to human health and happiness" will be considered at all.

Dreamers, too, are discouraged. Take heed, you Marconis with absurd wireless apparatus, you Edisons with silly phonographs, you Bells with imbecile schemes for telephoning! If your inventions possess no *commercial value* at the time they are conceived, if the world must be educated to use your machines you may not enjoy the privilege of having the Government work out your inventions for you. Go to the trusts, to Wall Street capitalists with your dreams. This is a practical Congress, a practical Government.

During the seventy years of the SCIENTIFIC AMERICAN's existence we have commented on more than one well-meant patent bill introduced in Congress by some representative of the people whose heart bled when he contemplated the plight into which inventors seem to fall. We have even advanced a few ideas on the improvement of the patent system ourselves—but hesitatingly and with some fear that the Constitution of the United States might in some way curb our philanthropic enthusiasm. But all those who have hitherto tried to better the lot of the inventor—ourselves included, we shame-facedly admit—must yield to the Hon. Samuel W. Smith in breadth of vision and largeness of heart. Compared with the epic magnificence of the project which is unfolded in his measure, far too modestly entitled "A Bill to establish an Inventors' Workshop," all other plans seem mean and niggardly.

A Place Where Wireless is Needed

THE island of Tristan da Cunha, in the middle of the South Atlantic Ocean, has from time to time been a source of worry to the British Colonial Office. Communication with this tiny colony of less than one hundred people is very infrequent and irregular, and as the resources of the island are limited, the inhabitants occasionally stand in need of outside assistance. In 1885 nearly all the able-bodied men of the island were drowned while attempting to board a vessel, and the survivors were for a time dependent for existence upon a supply of stores and provisions sent to them by a British man-of-war. Several unsuccessful attempts have been made to induce the people to abandon the island and settle elsewhere. At the present time the Crown Agents for the Colonies are inviting tenders for a license conferring the exclusive rights to occupy three neighboring islands—Nightingale, Inaccessible and Gough—for whaling, sealing and guano gathering, with the provision that whenever the licensees dispatch a vessel to or from the islands it shall touch at Tristan da Cunha for mails and goods, and that they shall also maintain good order in all the islands of the group. An admirable philanthropy would be the establishment of a wireless telegraph station in this isolated spot, after the good example recently set by an English newspaper in putting the little island of St. Kilda into wireless communication with the mainland of Scotland. Of course, such an undertaking in Tristan da Cunha would be far more costly both initially and for maintenance, owing to the great distance of the island from any existing wireless station.

The Aurora Borealis

SOME very interesting recent researches by Størmer and Birkeland on the Aurora Borealis render it probable that this phenomenon is due to corpuscular radiation proceeding from the sun to the earth. These corpuscles are doubtless electrons which are known to have great penetrative power. It is interesting to notice that these observations furnish a means to evaluate the actual degree to which the space in the solar system is a vacuum. It may be expressed by saying that it is as much rarer than the most rarefied vacuum yet produced experimentally as this latter is rarer than the ordinary atmosphere. The density of this interstellar vacuum varies within the limits of the solar system with its distance from the sun; and is doubtless very much more feeble in interstellar spaces far removed from any stars. Outside the Milky Way we may have a vacuum which is almost absolute. The subject has been fully discussed by Birkeland himself in the SCIENTIFIC AMERICAN SUPPLEMENT.

Dr. H. E. Hamberg retired from the directorship of the national meteorological service of Sweden on January 6th, and was succeeded by Dr. Nils Ekholm.

Electricity

Dissipating Fog by Wireless.—The North Railroad Company in France is making experiments on the use of wireless waves for clearing away fog. It is well known that electric waves act upon the water particles which make up fog, so as to dissolve them and turn them into vapor. Following this idea, it is claimed that as much as 600 feet can be cleared up in front of the electric wires which are sending out the waves, the fog being at least partially dissipated, and this will have a great value in practice, especially for railroads and vessels at sea. The latter will have time to avoid each other in this case.

Wireless Telephony from Berlin to Vienna.—Wireless telephony continues to occupy experimenters in various parts of Europe, and although we have no very remarkable progress to report within a recent date, we wish to mention some promising experiments which are being carried out between Germany and Austria. The Nauen wireless station, owing to its high mast, is favorable for long-distance working, and telephoning was done from this plant to the Technical Museum at Vienna, which makes the distance to be 300 miles or more. Owing to special apparatus of a new design, it was possible to hear newspaper articles which were read at Nauen.

Cleveland Electrical Exposition.—Cleveland is planning a great electrical exposition to be held May 20th to 30th in the Coliseum. The project is to be given under the auspices of the Electrical League of Cleveland. The Sixth City claims to lead the nation in many departments of the electrical trade. It is the headquarters for the greatest lamp works, the home of the biggest carbon manufacturing plant, and it boasts of three leading manufacturers of electric vehicles. It holds highest rank in the manufacture of electric cranes and hoisting machinery, and is a leader in the making of batteries. It claims many of the largest electrical machinery plants and its public service company is said to be a model of progress and efficiency.

Memorial to Wireless Operators.—As a memorial to wireless telegraph operators who have lost their lives at sea, it is planned to erect a fountain in Battery Park. The fountain will be of white granite with seats of the same material at either side. At the back will be a column upon which the names of the operators will be inscribed, as follows: Jack Phillips, S.S. "Titanic," April 15th, 1912, Atlantic Ocean. George C. Eccles, S.S. "Ohio," August 26th, 1909, Pacific Ocean. Stephen F. Sczepanek, S.S. "Pere Marquette," September 9th, 1910, Lake Michigan. S. Lawrence Prudhunt, S.S. "Rosecrans," January 7th, 1913, Pacific Ocean. Donald Campbell Perkins, S.S. "State of California," August 18th, 1913, Pacific Ocean. Ferdinand J. Kuehn, S.S. "Monroe," January 30th, 1914, Atlantic Ocean.

The New Army Automobile for X-ray Use, which is constructed on designs of the French army physician Major Busquet, is very complete and represents the most recent progress in this direction. In field work of the kind, it has been found difficult to operate the X-ray apparatus with good success owing to the various manipulations which must be carried out, and again a suitable photographic dark room has to be provided. Another point is that quite an amount of power is needed to operate the electric devices if any satisfactory results are to be had. A roomy automobile with 12 horse-power motor and a dynamo has now been developed, the inside of the car being fitted as a laboratory and dark room. A folding operating table is provided with the X-ray bulbs and all needed fittings, and a tent set up against the side of the car forms an operating room. The tent is then folded and stowed in the car. In time of war, it is claimed that all difficulties of operating will thus be overcome, and the car will also be of good service at all times, and can reach the spot quickly. Aviation centers can thus have good aid, especially where a large hospital is not to be found in the locality.

Increasing Motor Output.—A somewhat original method is used by the Brown-Boveri works to increase the amount of power which a given electric motor can be called upon to furnish; for instance, where a factory is using a motor rated at 500 horse-power, the new method allows of getting considerably more out of it, say 700 or 800 horse-power. This often makes it unnecessary to put in new motors for the increase of a plant, hence a great saving. The method depends upon the fact that in the induction motor the power factor often has a low value, so that the motor does not furnish nearly as much power for its size as it would were the power factor of higher value or near to unity. For rolling mill motors, where these are subject to severe strains and overloads at times, the motor must be very much larger than the average power would call for, hence it is an advantage to be able to use a smaller motor for the same power. This is done by a small extra device in the shape of a one horse-power motor, coupled to a rotating commutator, and this acts to change the value of the power factor and increase the output of say a large 1,000 horse-power motor with which it is used. The small device is connected to the circuit of the large motor.

Science

A Unique Collection of Books has just been acquired by the Library of Congress from Mr. Bertram Dobell of London. It consists entirely of works printed for private circulation, 1,500 in number, covering a wide range of subjects, and representing a labor of forty years on the part of the collector. Mr. Dobell has prepared an interesting descriptive catalogue to accompany the collection.

Mink Breeding.—A contribution to the growing industry of fur farming has been undertaken by the U. S. Biological Survey in the shape of experiments in breeding minks for size, quality of fur and disposition. A mink farm has been started near Prichard, Idaho, in the Coeur d'Alene National Forest, and similar experiments are under way in the National Zoological Park in Washington, D. C.

Earthquake Construction has now reached a very practical stage in the seismic districts of Italy, where all new buildings are being erected under strict supervision with respect to their ability to resist earthquake shocks. Prof. Omori, the Japanese authority, has estimated that 99.8 per cent of the deaths in the great Messina earthquake of 1908 would have been prevented if the buildings had been properly constructed.

The "Discovery," which was built for Capt. Scott's first expedition and was frozen in the Antarctic ice for three years, was subsequently sold to the Hudson Bay Company, and Scott was unable to obtain her for his second journey to the Antarctic. Mr. G. F. Stackhouse has, however, been more fortunate, having secured the use of this stanch vessel for his expedition, which is to seek King Edward VII. Land next Summer.

Martian Frosts.—The following telegram has been received from Lowell Observatory: "A late frost, a unique phenomenon, occurred on the night of March 3rd on Mars, in the region to the north of the Propontis, and was still visible at 2 o'clock of the Martian afternoon. The frost was parted from the north polar snow by the blue border, which was undoubtedly water, that marked the melting cap."

Suttee, the ancient Hindu custom of burning widows on their husbands' funeral pyres, was made illegal by the government of India in 1829, but cases of its occurrence are still occasionally reported. The London *Times* describes the voluntary suttee of a young widow last June at Yaraule, a village in the Mainpuri district. The act was carried out in the presence of a crowd of from 1,500 to 2,000 people. Several natives who assisted at the ceremony have been sent to prison.

The Death of Prof. Robert K. Duncan.—Dr. Robert Kennedy Duncan, Director of the Mellon Institute of Industrial Research of the University of Pittsburgh, died recently after an illness of several weeks at his home in Pittsburgh. He contributed articles on scientific topics to many periodicals, including the SCIENTIFIC AMERICAN. In 1907 he inaugurated at the University of Kansas a plan of industrial fellowships which subsequently has been developed to large proportions in that institution and at the University of Pittsburgh.

News from the "Polar Bear" Expedition.—A dispatch from the Signal Corps station at Circle City, Alaska, dated November 11th, announces the arrival at that place of a courier who brought a message 250 miles overland from the Arctic coast stating that the power-schooner, "Polar Bear," with a party of explorers and big-game hunters on board, is frozen in the ice off Demarcation Point, where it will, necessarily, spend the winter. All the party were reported well. A quite unusual number of vessels are understood to be fast in the ice along the Arctic coast of Alaska this season, including part of Stefánsson's Canadian Arctic expedition.

Casein.—Recent notable developments in the production and industrial uses of casein form the subject of an interesting report from Consul W. H. Hunt, stationed at St. Étienne, France. Casein, which is the principal albuminoid matter of milk, is now obtained by electrolysis, according to the following recently invented process: In the middle of a large vat full of skimmed milk heated to a temperature of 80 deg. C., a porous vessel is placed containing a 5 per cent solution of caustic soda; an iron cathode is plunged into the soda, and a rod of carbon, serving as an anode, into the milk. An electric current sets free the phosphoric acid contained in the milk, and the casein precipitates. As compared with the method of obtaining casein by the use of acids or rennet, the cost of this process is very low, the yield is greater, and the casein produced contains no foreign ingredients. Vegetable casein, now produced on an extensive scale from the soya bean, can be put to the same uses as animal casein. The principal use of casein is in the manufacture of galalith (milk stone), used as a substitute for ivory, tortoise shell, celluloid, etc. Penholders, frames, purses, phonograph disks, and a great variety of other articles are now made of galalith. It is also used as a chemical fertilizer. Several other casein products have recently been introduced.

Aeronautics

The "Loop" and its "Loopers."—Up to the present time no less than thirty-one pilots have looped the loop, according to *L'Aerophile*. Of these, Hamel, an Englishman, and Gilbert, a Frenchman, have looped the loop with passengers.

A New Tri-plane.—Eugene Bouillet of Long Island City, N. Y., has secured patent No. 1,084,248 for a triplane which has an upper supporting surface with the rearwardly projecting lateral tips, an intermediate supporting surface with controlling surfaces in its lateral extremities and a rectangular lower supporting surface, the said surfaces having substantial flat forward and rearward portions and a transversely extending arched central portion.

German Aeroplane Motor Competition.—Another aeroplane motor competition is to be held in Germany. The sum of $35,000 is to be awarded for the best water-cooled and air-cooled motors of 80 to 200 horse-power. The tests will determine general working of the motors, the efficiency, consumption of fuel, etc., and endurance. Among the points that will be counted in favor of a competing engine, the possibility of using cheap and safe material of German origin will be included. Points to be avoided are: Long duration of preparations for the tests, special requirements as regards lubricating oil, decline of efficiency in the long distance trials, vibration, breakdown of carbureters, an inconvenient shape for fitting into the aeroplane, and the supply of materials from abroad.

A Flying Tug-boat.—M. Maurice Colliex, who has been trying to solve the question of hydro-aeroplanes of large dimensions, capable of flying out over the sea for an entire day, made his first flight, recently, with a new gigantic sea plane, which might be called a flying tug-boat, built by the Voisin brothers. It has the regular ship-like under-structure characteristic of Curtiss hydro-aeroplanes, and looks something like a small river tug. Even the funnel in the middle is not missing. The hull of the little boat is 26 feet long, with a beam of 7 feet. The wings, which form a sort of tandem biplane, two super-imposed planes being at the back and two in front, are about 82 feet long, and have a spread of about 150 square yards of canvas. There are two motors of 200 horse-power each, and the machine is capable of flying with a useful weight of about two tons. It can carry oil and fuel enough for a flight of about 100 miles. Colliex tested the machine on the Seine, near Triel. It rose easily from the water, and alighted without difficulty.

Fog Observations for Aeronauts have been made regularly in Germany since March 1st, 1913, under the auspices of the *Luft-Fahrzeug-Gesellschaft*, at a small group of stations surrounding the town of Bitterfeld, where the service has its headquarters. Dr. Rotzoll, who is in charge of this novel undertaking, points out in his first report on the operations of the service that a foggy atmosphere is one of the greatest dangers encountered by airships, and it is therefore of the utmost importance to keep the aeronaut informed of the location of fog, its density, the height to which it extends, etc. Experienced meteorological observers are now keeping a record of fog at places around Bitterfeld, and are prepared to send reports by telegraph or telephone whenever called upon to do so. They report the density of fog in terms of "visibility-distance", i. e., the maximum distance at which certain prominent objects, such as steeples, smokestacks, etc., can be seen. In order to measure the height of fog, apparatus is now being constructed which will be sent aloft attached to a captive balloon or kite; when the instrument rises out of the fog into drier air the change in hygrometric conditions will be registered electrically at the other end of the wire leading to the ground.

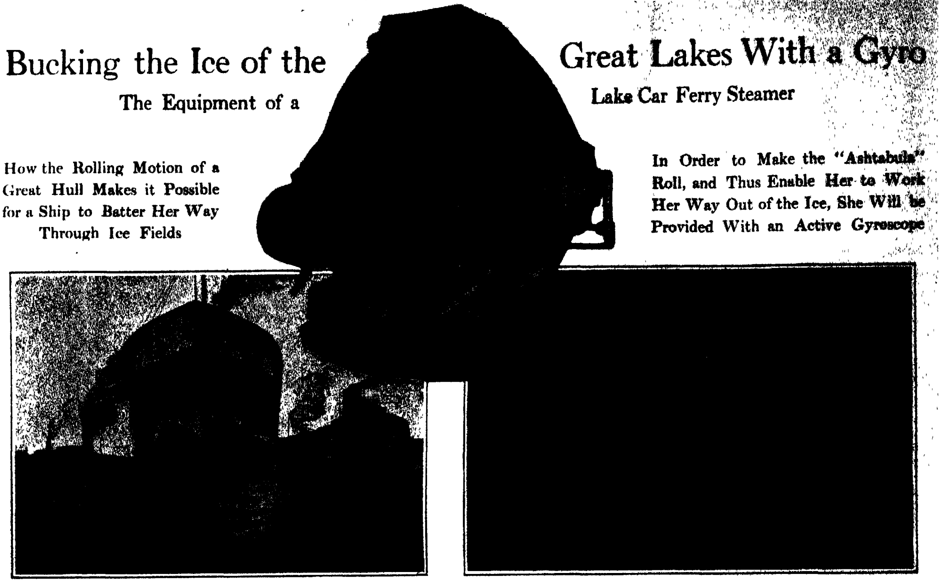
The Italian Air Fleet.—The Italian airship M-3 is finished and is now beginning her trials, while the P-3 has terminated those with success, and is said to be destined for Turin. These two additions to the Italian airship fleet bring its numbers up to ten, consisting of five of the P—piccolo = small—class, three of the M—medium—category, the "Citta di Milano," built by Ing Forlanini, and the "Parseval." We are informed by the *Engineer* that the first example of a new semi-rigid series, distinguished by the letter V after the designer, Capt. Verduzio, is under construction near Rome, and will have a capacity of 15,000 cubic meters (529,721 cubic feet) and a speed of 90 kilometers (56 miles). In Milan, another Forlanini vessel will soon be begun, with a capacity of 15,000 cubic meters, and therefore larger than the "Citta di Milano," besides having greater speed. The plans are also said to be well ahead for the new G—grande = large—type, which will be rigid and have a capacity of over 30,000 cubic meters (1,059,442 cubic feet). In the aeroplane department, three squadrons of seven machines will be added by June to the sixteen already existing. By the end of the year, there will probably be in Italy seventeen military aviation squadrons, each of seven aeroplanes, together with thirteen airships, of which the newest and largest will be the new Forlanini ship, the V-type unit, and the large G.

Bucking the Ice of the Great Lakes With a Gyro

The Equipment of a Lake Car Ferry Steamer

How the Rolling Motion of a Great Hull Makes it Possible for a Ship to Batter Her Way Through Ice Fields

In Order to Make the "Ashtabula" Roll, and Thus Enable Her to Work Her Way Out of the Ice, She Will be Provided With an Active Gyroscope



A big steamer on the Great Lakes having a channel broken for her by small tugs with special rudders.

The manner in which the stabilizing and rocking gyro will be installed on the "Ashtabula." G is the incased gyro; P is the precessing engine.

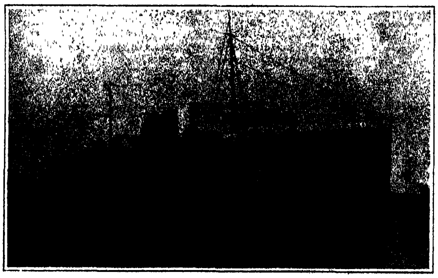
The gyroscope is shown in the top picture. C is the vacuum case containing the active type of gyro; E is the electric motor which drives the gyro.

MANY millions of tons of freight are hauled annually by vessels upon the Great Lakes, and many more millions could thus be carried were it not for ice. On an average, general navigation upon these highways of inland shipping is limited to a period varying from seven to eight months—depending upon the severity of the winter season.

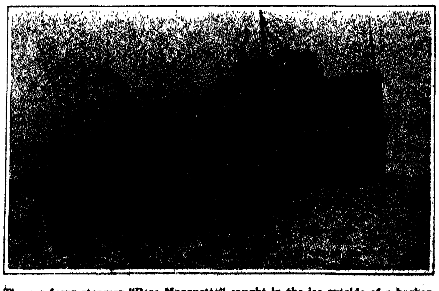
It is not necessary that the Great Lakes, from shore to shore, should be frozen over to halt the activities of freighters; it is quite enough to have harbors closed by the ice. In order to reduce the impediment of this lesser evil, it is customary to employ small vessels to break passages clear for inbound or outbound craft when the rest of the lake area is open to navigation. Strange though it may seem, these modest craft do what their big brothers, *the freighters, cannot do even though many* efforts have been made to fashion some of the lake steamers so that they can "buck the ice" effectively. Despite the fact that the Russian ice-breaker "Ermak" has done excellent work, that ship has its limitations. It is not always possible to get sufficient headway to ride up on the ice and break it down, as the "Ermak" does, and, besides that, she is fit for that service alone and powerfully—we might almost say extravagantly—engined for that work.

The ice-breaking tugs on the Great Lakes are equipped with exceptionally large rudders which can be swung quickly from side to side by a steam-steering engine and thus given a rhythmic rocking motion, tuned to their natural rolling period, by which it is possible for them to deliver first on one side and then on the other crushing blows to the ice while being driven vigorously forward by their screws. The result is a capacity to break the ice in a manner which the straight, bow-on attack of far heavier vessels would not accomplish even though it be possible for them to poke their stems up and on the floe.

The big car ferry steamer "Ashtabula," a vessel of 4,500 tons, is to be equipped with a unique apparatus by which that ship can be rocked like the small tugboats when attacking the ice. In this way, the rolling motion of her great body will make it possible for her to batter her way through the ice fields and to get in and out of harbor unassisted. The "Ashtabula" will be fitted with a Sperry stabilizer of the active gyro type, which when not in service to steady the craft in a seaway, can be made to roll her agreeably to her natural period. The Sperry installation will take up but a modest amount of space and will weigh less than one per cent of the ship's total displacement. When stabilizing the "Ashtabula" the mechanism will receive its inciting impulses from the waves themselves. When rocking the ship, the promoting action will be arbitrarily induced by a small auxiliary apparatus which will affect the two little pilot or sentinel gyros which bring the great gyros into action either to one or the other side.



The car ferry steamer "Ashtabula," which plies between Ashtabula Harbor, Ohio, and Port Burwell, Ontario.



The car ferry steamer "Pere Marquette" caught in the ice outside of a harbor.

Briefly, the active force employed is centered in a large rapidly revolving flywheel in which the principal mass lies in the rim, and the faster this gyro turns the greater its upsetting or corrective *energy when swung laterally to varying* degrees out of its normal fore-and-aft vertical plane of revolution. Thus, within a moderately small compass, an immense measure of disturbing or counter-balancing energy can be aroused. It takes but a relatively small amount of power on the part of a precession engine to turn the gyro to right or left as far as need be. Of course, when on duty, the big gyro is steadily spinning. The precession engine is called to service by two little gyros: one regulating the time of action and the other the degree of movement. These extremely sensitive sentinel gyros operate, by means of electrical connections, the throttle of the engine control and the manner of applying the steam to what we might call an ahead or a backing motion—in this case resulting in movements on the part of the gyro to right or left.

The object of the auxiliary apparatus referred to will be to artificially excite the pilot gyros by a purposely applied rocking motion. This, in turn, will be translated to the big gyro, and its periodic precession will cause the 4,500-ton ship to rock in unison. This opens up an entirely new field in the problem of breaking through ice that interferes with traffic, and the working of the installation in this case will be watched with intense interest by ship owners as well as engineers.

The 31,000-ton "Pennsylvania" of the United States Navy. She will carry twelve 14-inch guns.

The Problem of Our Navy

III.—The Decline of the United States Navy to Third-Class Rank

By the Editor

BETTER than any learned treatise could have done, the events of the Spanish war taught the American people the value of a preponderance of sea power. When Dewey crumpled up the Spanish fleet at Manila and Sampson strewed the southern coast of Cuba with the burning wreckage of Cervera's squadron, the decisive influence of sea power, always recognized by the naval expert, became self-evident, even to the man in the street.

The effect of this object lesson upon the country at large and its representatives in Congress was immediate. Proud of its navy and the international prestige which followed upon its victories, and realizing that what the navy had won a strong navy alone could keep, Congress lent a willing ear to its technical advisers, and systematically and most liberally set itself to the task of building up a navy that should be equal to the heavy responsibilities entailed upon the country by its acquisition of such widely separated possessions as Porto Rico and the Philippine Islands, and by its occupation of the island of Cuba. Our navy grew, literally by leaps and bounds, and within half a dozen years of the conclusion of peace it stood second in strength, with a commanding lead over that of Germany, having as its first fighting line not less than twenty-three first-class battleships built or under construction, to say nothing of eleven armored cruisers—the latter a type which Japan, not many months before, had not hesitated to place in the first line at the great battle of Tsushima.

But it so happened that in the very year, 1905, which found our navy in such a commanding position, there was built in England a new type of battleship, the "Dreadnought," which was destined to work a revolution in the relative standing of the navies of the world, by relegating all existing battleships to the second line.

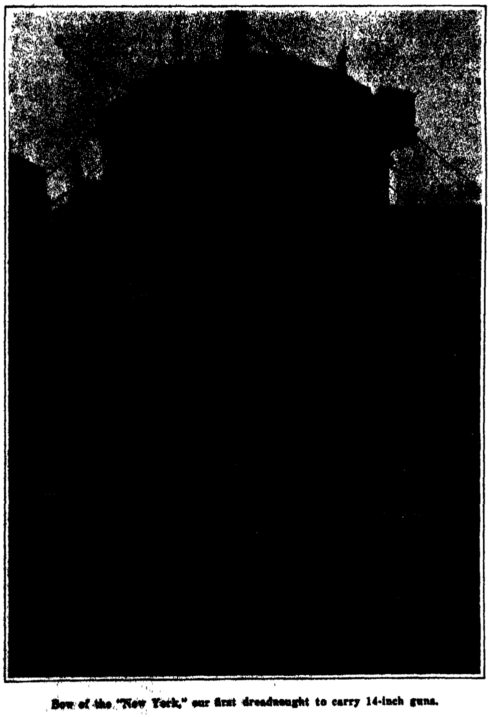
So vastly superior in size, speed, gun power and defensive qualities was the new ship, that it was recognized as the only type that could be used effectively in the first line of battle; and it was realised that the nation which could most quickly build and equip a fleet of these ships would hold the balance of sea power with all that this implies. The leading powers recognized that the dreadnought had entirely upset existing conditions, and all but ourselves accepted the burden thus laid upon them, enlarged their naval appropriations accordingly, and made haste to build up a new battleship fleet along dreadnought lines.

Unfortunately, Congress failed to appreciate the serious nature of the crisis; and at the very time when appropriations should have been increased to meet the new conditions, they were reduced—with the result that our first line of battle (and that means the navy, so far as the winning of decisive engagements is concerned) has sunk to the third rank, with France and Japan pushing us very closely for pre-eminence. But the story of the rise and decline of our navy since the war with Spain is told by the statistical figures of the following table.

APPROPRIATIONS FOR ARMORED SHIPS SINCE THE SPANISH WAR.

Date.	Battleships	Armored Cruisers
1898	Three	
1899	Four	Two
1900	Two	Three
1902	Two	Three
1903	Five	
1904	One	Two
1905	Two	
1906	One	
1907	One	
1908	Two	
1909	Two	
1910	Two	
1911	Two	
1912	One	
1913	One	

An analysis of the above table shows that in the seven years, including and intervening between the Spanish war and the opening of the dreadnought era, Congress authorized the construction of new battleships at the average rate of two and one half ships per year, and of battleships and armored cruisers combined at the rate of four ships per year; whereas during the eight years covering the dreadnought era, when a far-seeing Government would have accelerated construction, we have authorized new battleships at the low average rate of only one and one half vessels per year. And let it never be forgotten that during these years of decline in relative strength, our international policies have grown in scope and have been proclaimed with greater emphasis than ever before.



Bow of the "New York," our first dreadnought to carry 14-inch guns.

Why is the Dreadnought Supreme?

Now we can well understand that to many of the people of the interior States, and to many of their representatives in Congress, for that matter, the sudden announcement that their fine navy, for the upbuilding of which Congress had appropriated money so freely, has in a few years dropped to third-class rank, will come with a shock of surprise and provoke a strong doubt as to its truth. That doubt has been freely expressed, and by no one so strongly as by those senators and representatives whose constituencies are to be found in the interior States, where, in the nature of things, knowledge of naval affairs is not so broad, and familiarity with the development of naval *materiel* is not so intimate, as in the maritime States.

The present false conceptions of our naval standing, the failure to realize the imperative necessity for maintaining our navy in the very front rank among those of our possible competitors, and the indifference of the people and Congress to the fact that, ever since the dreadnought era began, we have been falling rapidly to the rear—all this is due to lack of information, to much positive misinformation, and more than anything else, perhaps, to a belief that no foreign power will dare to attack us—a belief which is founded partly upon our past naval successes and partly upon our feeling of national invincibility, that is to say, upon what remains of a certain traditional "lick-creation" attitude toward the great outside world.

But the day has gone by, never to return, when the ability of a nation to win a great naval war can be measured in terms of its material wealth and its undisciplined courage. *The modern development of the technical arts, to which this country has contributed so greatly, has put a heavy discount upon mere wealth and courage, and has set a heavy premium upon the material instruments of war—the 14-inch gun, the telescopic sight, the torpedo, the destroyer and the submarine!*

But the "man behind the gun"? Yes, we have a good man behind the gun; but so has Germany, so has Japan. The 14-inch, rifled gun, sending its high-explosive shell unerringly to the mark across five miles of water, is no respecter of persons. The stalwart American gun-pointer at one end of that five miles and the puny Jap at the other are toeing the line in a scratch race, a race which will be won, not by brawn and muscle, not by unconquerable courage, not by any dreams of a glorious past, but by the steady nerve, the keen eye, and the poise that comes of unremitting training and discipline in the years gone by.

Now let us carry the line of thought a little further and remember that what is true of a single gun is true of a whole ship's battery, and that, if gun is equal to gun, and the marksmanship is the same, by all the laws of probability, the ship that carries the greatest number of guns and delivers the heaviest broadside will win the fight

To-day, even more than when Napoleon uttered his famous dictum, it is certain that "Heaven fights on the side of the heaviest artillery;" and it is because the dreadnought carries a broadside of such overwhelming superiority that no pre-dreadnought can engage it with the slightest hope of success. A 12-gun "Wyoming" might silence a 4-gun "Connecticut" in the first five minutes of an engagement, and in 10 minutes might conceivably leave it in a sinking condition But, according to Representative Witherspoon and the "small navy" men in Congress, matters would be equaled if twelve 4-gun "Connecticuts" were pitted against four 12-gun "Wyomings;" and since herein lies one of the most plausible fallacies of those who fail to see the importance of the dreadnought question, we shall now give, *seriatim*, the reasons that have relegated all but twelve of our thirty-nine battleships to the second line.

I. *Overwhelming concentration of gun-fire.* It is generally agreed that because of the danger of fighting in the head-on position (which exposes a ship to the risk of a raking fire in which more shells would strike and when they struck might pass through the whole length of the vessel), that future engagements will be fought broadside to broadside, with the two fleets traveling on parallel courses, and the ships disposed in "column formation," that is to say, ship behind ship, with a suitable interval of about 450 yards between the stern of one ship and the bow of the ship that is next astern. In this formation a line of four "Wyomings" would be roughly about one mile in length, and a line of twelve "Connecticuts" nearly four miles. The "Wyomings," because of their superiority in speed of about three knots, would elect to place themselves opposite the head of the column of "Connecticuts," and in these relative positions, the four "Wyomings" would be able to oppose forty-eight 12-inch guns against the sixteen 12-inch guns of the four leading ships of the "Connecticut" line. The "Wyomings," having the advantage in speed, would elect to fight at a maximum range of 10,000 to 12,000 yards, and since the successive ships down the "Connecticut" line would be at increasing distances from the "Wyomings," the after part of their line would be out of effective range. The result would be that the four "Wyomings" would be able to crush the head of the "Connecticut" line by overwhelming gun fire, and then commence dropping back until the whole fleet had been silenced The "Wyomings" would be punished, of course; but their enormous volume of fire would fairly smother that of the ships at the head of the enemy's line and would afford a strong protection against his gun fire.

But suppose that the twelve "Connecticuts" found themselves in line against twelve "Wyomings," with forty-eight 12-inch guns opposed to one hundred and forty-four!

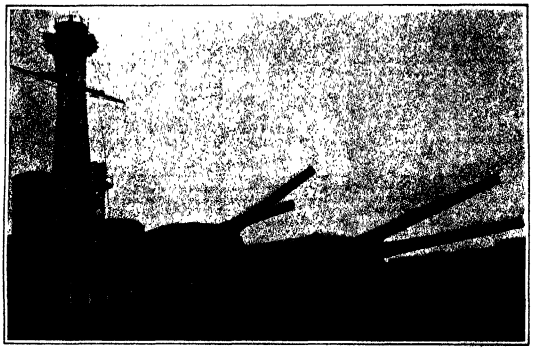
II. *The all-big-gun battery makes salvo firing accurate.* The fact that only one caliber of gun is carried in the dreadnought's main battery gives it an enormous advantage over the pre-dreadnought. The "Connecticut" carries 12-inch, 8-inch and 7-inch guns. If all of these are engaged, it is impossible to distinguish the splash of the several guns, and the work of the spotter is rendered difficult and uncertain. With the guns all of one size, the spotter can determine the mean point of fall and correct the elevation of the whole ship's battery accordingly. Because of the terrific punishing power of the 12-, 13½-, and 14-inch gun, the commander-in-chief will prefer to fight his dreadnoughts at the maximum range at which he can hit the mark and trust to the accuracy of his fire to land on the enemy that first salvo which will go far to win the fight. At such ranges, only the four 12-inch guns of a "Connecticut," "Georgia," or "Maine" would be available—and even these, being of an older type, would be greatly outclassed by the more modern guns of the dreadnought. The 8-inch, 7-inch and 6-inch guns would not even be manned during the fight

III. *The more modern equipment* of the dreadnought's guns would enable them to do more accurate and faster firing.

IV. *The armor of the dreadnought* is thicker, of better quality, and is better distributed.

V. *The saving in personnel on the dreadnought* is a most valuable feature. The "Connecticut" carries 1,000 officers and men for four big guns, the "Pennsylvania" carries the same number for twelve big guns—250 men per gun for the pre-dreadnought and only 84 per gun for the dreadnought.

VI. *Lastly, the relative damage of a hit by torpedo or gun*, tending to sink the ship, is one half as great on the 31,000-ton "Pennsylvania" as it is on the 16,000-ton "Connecticut." Furthermore, the compartmental subdivision of the dreadnought as a protection against mine and torpedo is more elaborate and effective than on the pre-dreadnought type.



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The forward 14-inch guns of the United States dreadnought "New York."

We have said enough to show that the dreadnought, as a fighting unit, is in a class by itself. To send a fleet of pre-dreadnoughts out to fight a fleet of dreadnoughts would be suicidal. The case was aptly put by Mr. Daniels, the Secretary of the Navy, in his examination before the House Naval Committee, when he said that the captain who fought a pre-dreadnought against a dreadnought would be deserving of court-martial.

On the new dreadnought rating, then, where do we stand? Naval statistics show that there is one first-class navy, the British, with forty-two of this type built and building; one second-class navy, the German, with twenty-six such ships; and three navies of the third class, that of the United States with 12; France with 11 and Japan with 10 dreadnoughts. And both France and Japan, be it remembered, are building faster than we. They are adding to their dreadnought fleets at a rate which in a few years' time will relegate us to the fifth position.

Unless Congress listens to the advice of our Naval Board, the drop of the United States to the low rank of fifth in naval strength is as certain as the ebb and flow of the tides and the rise and setting of the sun.

And what then?

The Scientific American is opposed on principle to the forecasting of possible hostilities with powers with which the country is on friendly terms; but in the present article such a forecast seems justified as proving the disastrous results which might follow from our neglect to provide a navy equal to our needs.

Let us suppose that two years from now Great Britain, estranged by our breach of faith (in the event it should not be rectified) on the canal tolls question, agreed to maintain an attitude of neutrality, while Germany, by the purchase of a base in the West Indies, challenged our Monroe Doctrine in its relation to the security of the Panama Canal. Let us suppose that, released from anxieties at home, Germany dispatched her whole first line of twenty-six dreadnoughts, and her second line of fifteen pre-dreadnoughts (including all ships dating since 1901) to the Caribbean. Where should we stand? Against her twenty-six dreadnoughts we could oppose twelve; against her fifteen pre-dreadnoughts we could oppose sixteen of the same date. Can anyone suppose that our first line could prevail against one of more than double its strength? And with the ships of our first line sunk, captured, or fleeing for a home port, what would become of our older ships, when the victorious first and second line of the enemy joined forces to crush our remaining second line, composed of "Connecticuts," "New Jerseys," and "Maines"?

And suppose Japan, smarting under the sting of our Asiatic exclusion, seized the opportune time, and swept down upon the Philippines, Guam, Hawaii, and, with no fleet to cut her lines of communication, established a base upon the Pacific Coast, and began to land her veteran troops of the Russo-Japanese war. That would be a startling object lesson in the necessity for the provision of adequate sea power by a nation so situated as our own—an object lesson, the meaning of which the people, even of the States most remote from the sea, and most opposed to the growth of our navy, surely would not fail to grasp.

Meteorological Service in the Caribbean

THE next agricultural appropriation bill will probably provide for the establishment of about sixteen meteorological stations in the West Indies and elsewhere about the Caribbean Sea, under the direction of the United States Weather Bureau, for the purpose of maintaining an efficient storm-warning service in that part of the world. The need of such a service will, of course, become especially urgent with the opening of the Panama Canal. The first extensive meteorological service in the Caribbean was established by the Weather Bureau in 1898, primarily for the protection of the American fleet during the war with Spain. Shortly after the war most of the regular observers were recalled, and the work was continued on a small scale by native observers, cable operators, and the like. In recent years a telegraphic weather service has been maintained only during the hurricane season. The new stations will telegraph twice-daily observations throughout the year, and wireless telegraphy will be employed at places where the regular telegraph facilities are not adequate. A central observatory will be established in the Canal Zone. Wireless weather reports from and to vessels will form an important feature of the new service.

Development of the Parcel Post

THE last annual report of the Postmaster General, published in December, states that during the first six months of the parcel post (January to June, 1913) approximately 300,000,000 parcels were handled, and of this number more than 2,500,000 were insured. Insurance rates were readjusted on July 1st, so that insurance up to $25 costs only 5 cents, and from $25 to $50, 10 cents. A collect-on-delivery service was established July 1st; charges up to $100 are collected for a fee of 10 cents. Increases in maximum weight limits and reductions in rates of postage for certain zones have twice been made since the parcel post was established. Nothing could better justify the existence of the new service than the fact that twenty million rural dwellers now have a house-to-house collection and delivery of parcels; a luxury once peculiar to cities and towns. An important step now in contemplation is the consolidation of the third and fourth classes of mail. Books will be admitted to the parcel post on and after March 16th, 1914.

The Kaibab and the Coconino National Forests adjoin each other. Yet it takes from two to three days to go from one to the other across the Grand Canyon of the Colorado.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Leinert Liquid Weigher

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of January 24th, in a short paragraph describing the Leinert liquid weigher, you state that this apparatus "consists of a pair of equal-sized tanks so arranged that when one is filled up to a standard level, it automatically shifts the feed to the second tank." This is an error, as when one tank is filled to a definite weight, it automatically shifts the feed over to the second tank.

New York. THE LEINERT LIQUID WEIGHER CO.
W. LEINERT.

How to Use Old Decayed Elms

To the Editor of the SCIENTIFIC AMERICAN:

Knowing of the ravages that certain beetles and pests have been making with the grand old elms in Massachusetts and other nearby States, may not the following suggestion prove of advantage to owners of trees so killed or dying?

When the owner of such valued trees sees that they are going to die and that nothing can be done to save them, instead of cutting them down, allow them to remain as before. At their base, after careful preparation of the soil, plant a great abundance of Virginia creeper or woodbine, or some rapid-growing vine that will stand the winter freezes. In time such growth will entirely cover the tree, reaching to the farthest limits, and instead of having a bare skeleton of the past beauty, it will again bloom with a grandeur not before known.

Possibly some vine or creeper can be found that will prove much better for the purpose than the two mentioned. The State authorities could well give this careful thought, and following intelligent experimenting, again beautify the remains of past glory.

Los Angeles, Cal. PIERSON W. BANNING.

Snow Removal

To the Editor of the SCIENTIFIC AMERICAN:

If a road-maker with tons of earth to dig away in the shortest possible time should propose to do the job with hand shovels he would not be likely to receive the contract. Yet this antiquated method is regarded as sufficient when it comes to clearing a great city of snow! And why? Probably because it has never occurred to anyone that more effective means might be devised. And yet it would seem perfectly feasible to apply to snow removal something of the modern methods used in removing dirt. A power shovel, mounted on a motor truck, operated by the same power that operates the truck, would seem not difficult to invent. Horse ploughs that pushed the snow from the middle of the street, leaving it in a continuous high ridge along the sides, could then be followed by such power shovels to load the snow into wagons. Without figures at hand it is impossible to say with accuracy how much faster such loading could be accomplished, but it is evident that it would be many times speedier than hand shovelling. And a power shovel would be able to handle frozen snow as readily as loose snow.

The objection will be raised that the present slowness is caused not alone by the men; that sufficient horses and wagons cannot be procured for swifter removal. This raises a second consideration; the possibility of greater co-operation between the city cleaning departments and the street railway companies. Why should not the latter's rails and power be used to aid the city by hauling the snow wagons across town? It is as easy (or, if not, it could readily be made easy) to hitch a wagon behind a service car as behind a horse. Thus the horses, having a shorter haul—only from the point on whatever avenue is being cleared to the nearest cross-town line—could do more hauling, and any given wagon would make several times the present number of trips. Of course this would involve some inconvenience to cross-town passengers; but such power-hauling might be resorted to only out of rush hours, and at night.

And in another way the railway companies could aid. At present a plough or a brush runs down the tracks, throwing the snow into the roadway for removal. Thus the amount of snow in the roadway is doubled, and half the snow in the street is handled twice. What would Col. Goethals have thought of a proposal to throw the dirt of the Culebra cut into some other part of the canal! Surely it ought not to be very difficult to construct a "plough" on the vacuum, or other suction principle, which, started out as soon as the snow began to fall, should draw it up and pass it through a pipe to a trailing car or cars of the "gondola" type—"coal cars" commonly called. It would not be necessary for the railway company to own these cars, as they could doubtless be hired for the occasion from the steam railroads.

It may be said that the expense of such methods would be prohibitive. That may be questioned. There would be a great saving in the hire of men; if not through a reduction in the number of men, it would certainly come in the number of hours of work. This would offset the expense of equipment. And it cannot be urged that this equipment would be used only after the heavy falls of snow that occur rarely. Even after a light snow vast piles are accumulated at intervals. The power shovels would remove these piles instead of the long ridges. And, even if the item of expense is still brought up, the loss to the city by street delays and congestion is too great to allow the argument to have much weight. Certainly when "power" has been so successfully applied to all other engineering problems to supplement and expedite hand work there is no need to lag behind here. And the removal of snow from the streets of a vast city is, in a way at least, an engineering problem which can be solved largely through the application of "power." P. A. HUTCHINSON.

New York.

An Improved Box for the New York Fire Alarm Telegraph

By Herbert T. Wade

FIRE alarm telegraph apparatus, in the opinion of many electrical engineers, has failed to keep pace with other departments of the application of electricity, notwithstanding the fact that upon its operation depends the safety of life and property. In this connection the fire alarm telegraph can be appropriately compared with railway signaling, where absolute sureness of operation must be provided and failure absolutely obviated. Indeed, the analogy could be pursued further and the similarity of circuits, their location and operation exposed to conditions of weather and temperature, their lack of attention requiring automatic operation, and their infrequent and irregular use, could be emphasized.

Accordingly, progressive electrical engineers interested in fire alarm telegraph are paying more attention to railway signaling and endeavoring to apply some of the solutions of problems that have been achieved amid the rapid development of this art.

But this involves a comparison between what is best in modern fire alarm telegraph practice and theory rather than with actual conditions as they exist to-day in many cities, and particularly in New York, where circumstances are such as to compel the reconstruction of the fire alarm telegraph as rapidly as appropriations are available. In this reconstruction, which for lack of means is taking place piecemeal, it is necessary to provide new elements of the best quality that will fit into the final scheme, yet at the same time will work under present conditions. There are on the market fire alarm boxes of the non-interfering and succession type, which, under good conditions of maintenance and especially with proper circuits, can be operated so as to eliminate the interference of two or more boxes operated simultaneously on the same circuit, but it must be remembered that in any city, and especially in New York, the status of the underground conductors frequently changes and that faults due to various causes, crosses from high tension electrical conductors, and other failures, are likely to develop. While in New York in particular not only are the present cables and circuits in the main badly arranged and maintained, but often as many as 50 boxes, and most of these of an antiquated and ineffective type, are placed on one circuit where 10 or 15 at the most would be considered good practice.

With such conditions in mind and new boxes required for natural extensions as well as for much needed replacements, it occurred to Mr. Leonard Day, sometime chief of the fire alarm telegraph bureau of the New York Fire Department, that a box should be developed in which all the features of the best non-interfering and succession boxes should be preserved, but in addition there should be considered further protection in view of the many defects which exist in the present circuits and which in less number might reasonably be expected under any future circuits installed under more effective conditions and of better materials and design.

It will be recalled that the making and breaking of a circuit for sending an alarm signal from a box in a fire alarm telegraph is produced by the revolution of a disk notched at its circumference, so as to afford teeth which engage a follower operating the circuit-breaking mechanism proper. The number and spacing of the teeth on the circumference of this wheel gives the signal of the individual box. Thus, if there is one tooth followed after an interval by two, and after a second interval by three, the signal 123 will be sent in to the central station. This wheel revolves by clockwork when the hook in the street box is pulled by the person sending the alarm, and makes a certain number of revolutions. The circuit thus broken and made affects a sensitive relay at headquarters, and this actuates a second circuit connected with the recording and indicating mechanism, so that the appropriate signal can be sent out to the gongs and indicators in the fire houses on other circuits.

With several boxes on the same circuit it is quite conceivable that two or more boxes might be pulled simultaneously, as has been said, and the signal either be totally destroyed or come in badly jumbled, or in case the circuit is broken, no signal transmitted at all.

In the new New York box developed by Mr. Day and Mr. E. A. Faller, the first revolution of the wheel tests out the circuit and, if it is perfect, the ordinary transmission over the metallic circuit takes place. If, however, the circuit is faulty, the line is automatically grounded on the side where the fault occurs and the signal is sent to headquarters through the ground and over the part of the line that is in good condition. This is accomplished by having an armature released after a single revolution and then by a snap switch connecting the circuit to the ground. The operator at headquarters in the meantime has received a danger signal showing that the circuit is broken, and he immediately turns down a knife switch, putting on to the particular box circuit indicated a powerful split battery sufficient to overcome any resistance, so that the current properly interrupted by the contact wheel can be returned through the ground and the signal received in the usual way. Thus it will be seen that whatever the length of the circuit or the number of boxes, it is possible in case of a break or failure, to use the ground with the portion of the circuit intact, the only contingency not provided for, and that very remote, being where a box between two faults is cut off from the central station.

Another important feature of the new box, and one which is common to all the essential elements of the reconstruction of the New York fire alarm telegraph, is that these boxes are absolutely interchangeable. Should a street box be impaired, a mechanician can be dispatched at once carrying a substitute box in a small case, and it is the work of but a moment to remove the mechanism of the box that is out of order and replace it with one in proper condition. This obviates the unsatisfactory and inefficient method of street repairs and insures better work at the instrument shop at the central station.

The new box is remarkably simple in its construction, and is so arranged that large quantities can be made by proper and modern mechanical methods. The fundamental patents on the Gamewell non-interfering succession box, which has been largely used throughout the United States, expired on February 14th, 1913, so that it is possible to make use of all desirable features of this well-known instrument, but, at the same time, the New York box is distinctly in advance of any previously constructed, and its installation in sufficient numbers will prove most valuable in the scheme of reconstruction now in process. This reconstruction of the New York fire alarm telegraph involves the provision of new central stations in three of the boroughs, new switchboards and other central station apparatus.

Barranquilla to be Made a Seaport

A LAW has been signed by the President of Colombia providing for the opening of the bar at the mouth of the Magdalena, in order to give sea-going vessels access to the city of Barranquilla, the commercial metropolis of the country. At present goods and passengers bound for Barranquilla are landed at the makeshift port of Savanilla, or Puerto Colombia, which is an open roadstead, and requires one of the longest piers in the world to connect the shore with water deep enough for berthing vessels. A narrow-gage railway runs thence to Barranquilla. The new channel in the Magdalena will admit vessels drawing 30 feet of water, and suitable piers and warehouses will be erected at Barranquilla. This city is the starting point for the flotilla of river steamers which run up the Magdalena—the first stage in the most traveled route to Bogotá.

Citrus By-Products

THE problem of utilizing waste oranges and lemons has recently been studied by the U. S. Bureau of Chemistry with interesting results. It is found that lemons which have previously been discarded will yield from 15 to 60 pounds of citric acid per ton, so that at the prevailing market rate of the acid these culls are worth from $5 to $25 a ton. Other promising by-products are the essential oils of orange and lemon, 60 per cent of which can be recovered by methods recently devised. As much as 6¼ pounds of essential oil has been obtained from a ton of fruit, and it is worth from $2.50 to $5 a pound. The gross maximum income per ton from the best quality of culls would approximate $45. It is understood that a number of companies are considering the manufacture of these by-products.

Dr. Bell's Contribution to Radium Technology.—In the SCIENTIFIC AMERICAN of September 12th, 1903, there appeared a letter from Dr. Alexander Graham Bell, in which he suggested the imbedding of radium in bodily tissue as a curative agent for deep-seated cancers. This is probably the first suggestion of a method of treatment which is now in vogue among medical men.

The Biggest of French Dirigibles

By Carl Dienstbach

ONE of the most vexing problems of aeroplane design is to minimize the air-resistance of the many bracing wires or cables. In dirigible design inventors originally worried still less about the ropes by which the car was suspended from the gasbag than early aeroplane experimenters about the "wiring" of flying machines both laboring under the erroneous impression that compared with the supposedly enormous resistance a balloon or even a large plane offered to propulsion, that of a thin rope or wire was trifling. Modern aerodynamic research has changed this view. Air in motion has been photographed, and it has been discovered that around a properly shaped balloon or plane air will so smoothly part and close again that it will escape easily without impeding the moving body. But a rope or wire will always push the air along bodily. Who has not wondered about the grip of the wind on an ordinary signal halyard, if one tries to straighten its curve by pulling? In the wake of a long thin cable the wind is all broken up into eddies, and if there is a bundle of wires or ropes, this effect is so aggravated that the air seems to be eventually "raked" along almost like so much hay. Practice has proved this no less than theory. When the writer once complimented Major von Parseval on the picturesque appearance of his "full-rigged" airship, he protested that the waste of power due to this very beauty was extravagant

Little attention was at first paid to the fact that even in the first rigid dirigible of 1900 Count Zeppelin had incidentally reduced this trouble to a minimum. It was little wonder that no sooner did the Zeppelins cease to remain badly under-engined compared with other dirigibles of corresponding displacement, than they began to attain speeds undreamed of in "lighter than air" machines. By an ingenious improvement of the original suspension the Parsevals soon managed to follow suit to a degree, because their outlines, showing only envelope and one small car, were also simple But French designers, clinging to unpromising types of large suspending stiffening frames, never equaled German speeds. Not even in details did they betray an attempt to reduce resistance against propulsion, a photograph of a French car showing a veritable jungle of exposed framing

Germany's "Gross-Basenach" type of army design, though its suspended stiffening frame was carefully incased in cloth and made of a slender streamline shape from the outset, has on the other hand recently fallen into a certain disrepute French manufacturers faced no easy problem when the government called on them to equal the speeds of Zeppelins, finally realizing that strong as they were in aeroplanes, an entire absence of speedy dirigibles might be fatal

While experiments with a French rigid airship, the "Spiess," essentially a frank Zeppelin imitation, were progressing with a slowness dictated by the fate of the British "Mayfly," the Spanish engineer Torres came to the rescue. Some ten years ago he invented a fundamental improvement in non rigid airships. Laboring under the inherent difficulty of the tremendous outlay required to demonstrate a new idea in dirigibles on a scale large enough to be conclusive, which only Zeppelin was able to conquer, he offered his invention to the French Astra Company, after a futile attempt at embodying it in a Spanish dirigible of pygmy dimensions. They tried it at least on a practical scale by building after his plans one of the small so-called "vedettes" (short-range scouts) for the army, of some 1,500 cubic meters displacement The result was an unqualified success. The modest "vedette" was able to play with the big crack cruiser "Colonel Renard," of over 8,000 cubic meters, which had won the race for dirigibles at the first aeroplane meet at Rheims.

The next Astra-Torres was not lacking in size (8,000 cubic meters). It was built for the English government simultaneously with an advanced Parseval of similar dimensions, which it easily surpassed, developing well over fifty miles an hour at the official speed tests. This lesson was not lost, and now the first mammoth Astra-Torres of 23,000 cubic meters for the French government is nearing completion. It is expected to beat the new Zeppelins, because it mounts 1,000 horsepower engines on 5,000 cubic meters less displacement, thanks to the weight saved in dispensing with the rigid frame (the whole structure weighing only 16 tons), yet the rakish slenderness (the Astra-Torres measures 110 meters in length by 19 meters greatest beam) of a rigid hull and its unchanging shape, which Count de la Vaulx, in piloting the "Spiess," found such a blessing to the helmsman, have also a say in that matter.

The wonderful invention of Torres, on which such high ambitions are based, was very simple and obvious. That von Parseval did not make it was a wonder, as he virtually had it in his hand when establishing his elaborate tackle inside the gas space for controlling his airbags. It shows strikingly what constitutes the true inventor. Torres simply conceived the immense advantage of bracing a dirigible inside the gas space, which sheer habit of early ballooning had forbidden. This conception is indeed fundamental and involves the essential superiority of the dirigible over a mammoth aeroplane. Both types need an increasing amount of bracing as their size grows larger. But the necessity of exposing the braces, whatever they be, to the supporting air current in the aeroplane, whereas they can be all safely stowed away inside the streamline, gas-inflated body of a dirigible, eventually most curiously reverses the speed relations of aeroplane and dirigible. A mammoth aeroplane may be said to be just as much slower than a dirigible as a normal aeroplane is faster. The essence of the Torres invention was shown by the writer in the columns of this paper in his study of the dirigible of the future in 1911, where not only bracing is seen criss-crossing the interior of the hull, but where cables are run through the very gas. Just as von Parseval did not see that his suspension could be placed within the gas as easily as his airbag control, Torres did not see that an empty folded gas container was not a necessary condition of running ropes through the space later occupied by the gas. The idea of employing a "smoke helmet" or a modified diving suit to attach such ropes anywhere right in the gas space of a rigid dirigible, after inflation, would seem most obvious, if it did not involve the unused chance of doubling the strength of a Zeppelin, with all its consequences of saving dead weight and gaining speed. The simplest way to describe the Astra-Torres is in referring back to the study of the airship of the future mentioned above, where a rigid quadrangular structure divided the interior of the cylindrical hull. In the Astra-Torres this same structure is made triangular, equilateral, with the base line on top, and of course of flexible cloth bands, connecting the three principal longitudinal seams of the envelope. It fulfills the identical purpose of taking part of the supporting upward pressure of the gas off the side of the hull and transmitting it straight down; as the French say, it makes the envelope "labor" less. Along the upper corners of this triangle a system of suspension ropes is attached which much resembles that of the old Parsevals in its rapidly diminishing ramifications; only the ropes of course do not bear against the outside of the envelope, but converge in straight lines through the gas space, and to facilitate their egress to the air the few final cables are first caught from both sides in a "collecting ring" to which a short vertical cable (there are ten for each car) is attached, which passes through a protecting ring in the bottom of the envelope and on the outside branches again into two diverging cables running to the two sides of the cars. For greater strength they are fastened to both sides at the bottom. For some distance they are incased in an "accordion" sleeve or hose outside the hull, which communicates with the gas space and is glued to the cable at its sealed lower end, preventing escape of gas under pressure, yet permitting that amount of play for the cable which is necessary in a flexible, elastic structure.

The internal bracing being too simple to keep the envelope cylindrical (a more complicated system might be in imminent danger of getting entangled while the empty envelope is laid out for inflation), the hull of the Astra-Torres shows the characteristic shape of three separate bulging ridges, giving an unpleasantly large outside surface, which, with its frictional resistance, is regarded as a lesser, necessary evil. Attaching ropes after inflation would obviate it. The general outlines, two cars with stiffened funnels through the envelope to observation and gun platforms on top (riding there on a sort of "saddle frame"), the concentration of all steering and stabilizing planes at the poop of the hull, are obvious adoptions from the Zeppelins, while the accompanying detail of a car shows the best features of Parseval practice, such as two motors for each "Chenue," of 250 horse-power each, each driving its own screw, improved propeller mountings of small air resistance. There is the well-tried Astra spring mounting for the motors and the convenient Astra "bridge" for the captain and his staff, but it is

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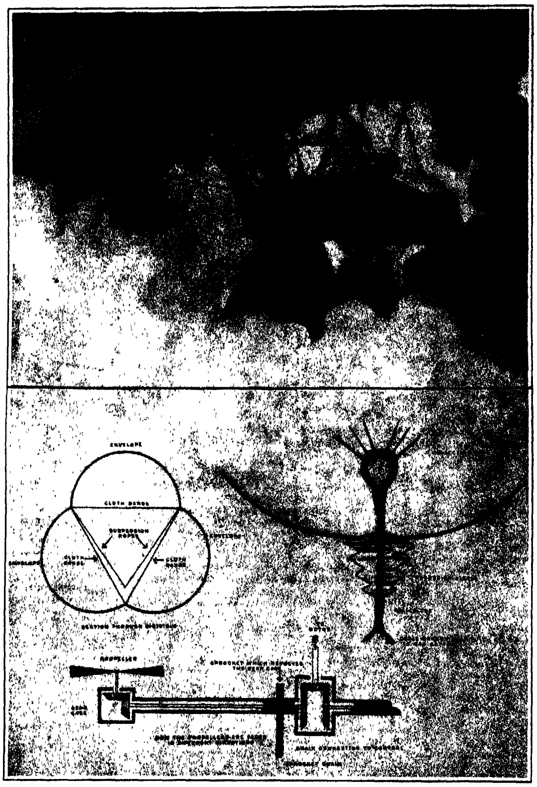


Details of the mammoth Astra-Torres.

Her gas capacity is 23,000 cubic meters. Her engines deliver 1,000 horse-power Her length is 100 meters The gas bag is braced within by cloth bands This bracing transmits part of the supporting upward pressure of the gas straight down. A system of suspension ropes leads down from this bracing, the ropes being first caught from both sides in a collecting ring to which a short vertical cable is attached which passes through a gasket in the bottom of the envelope.

How to Leave Yourself at Your Tailor's

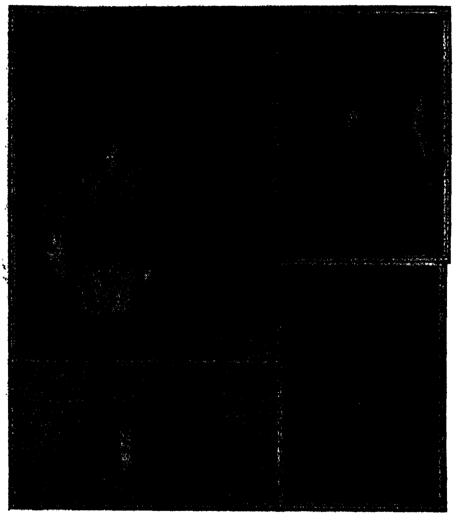
WHEN your measure is taken by a tailor he lays his tape about your chest, your waist, along your arms and your legs, in accordance with a system which tradition has laid down. However carefully he takes his measurements, the clothes must be tried on at least once and even several times if you are a very particular man. It would be more convenient if you could leave yourself, as it were, at your tailor's and proceed about your business, knowing that when your clothes are delivered they will surely fit you.

This paradoxical achievement is the fundamental idea of a German invention which has been introduced in America by a well-known New York tailor. The German inventor has actually devised a means of creating your artificial double, which your tailor uses exactly as if he had your own person to drape.

First of all you slip on a cheese cloth or linen coat, whereupon your tailor proceeds to wrap gummed paper over you with a special contrivance. He wraps the paper around your waist, passes it around your shoulder and sees to it that the edges overlap. When every part of your trunk is incased in wrappings, like an Egyptian mummy, the first stage in the preparation of your artificial double has been completed. The wrappings dry very quickly, and become hard and impervious to air. When they have reached that condition, the wrappings are slit up the back, as one of the accompanying illustrations shows. A cast of your trunk has been obtained as it were, which is peeled off like an orange skin. The wrappings are then placed upon an inflatable rubber bag of the proper shape and fastened in place. Next the rubber bag is blown up, and the wrappings are filled out and assume the exact shape of your trunk. Your artificial tailor's double has been created.

Once your measure has been taken in this novel and very accurate way, you may cable your order for a suit of clothes from Kamchatka with the certainty that when they reach you they will fit you as if you had tried them on.

The device with which the wrappings are applied is very simple. Its details are very completely revealed in one of the small illustrations published herewith. A reel of special paper passes under a guide roller, past a wet sponge and over a serrated guiding edge. The reel, the guide roller and the serrated edge are held together by a casing which is hinged on one side, so that all the members can be taken apart.



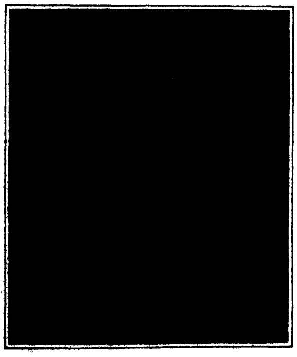
A way of creating an artificial double of yourself for the use of your tailor. You are wrapped in gummed paper, the wrappings are cut at the back and peeled off, and the shell of yourself thus obtained is placed over a rubber bag which is blown up and thus assumes the form of your trunk.

Another Automobile Head Lamp

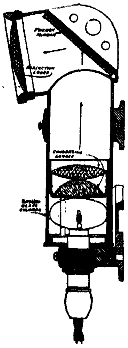
ALTHOUGH automobile engineering has progressed marvelously during the past few years, the fact remains that until very recently comparatively little attention has been paid to lamps and lighting systems—barring the introduction of electricity as an illuminant, of course. We have better illumination of objects as viewed from behind the driver's controls, what with high-power tungsten bulbs and parabolic reflectors, but the numerous unsuccessful attempts that have been made to control the blinding glare that is such a menace to the operators of approaching vehicles makes plain the inherent defect of such systems. Now, however, there has been placed on the market a radically different type of automobile head lamp in which the inventor has sought to eliminate the glare by the simple expedient of controlling the beams of light and confining them in such a way that they are projected in nearly parallel lines. Thus, by placing the lamps themselves rather lower than is usual and directing the light beams slightly downward, so that those approaching the lamps, even on foot, find it impossible, without glancing directly along the projected beams, to be blinded by the "flash" of the projecting lens, the object is attained. The secret of the success of the lamps lies in the fact that the circle of light projected has an absolutely sharp edge even to the limit of projection. The projection renders objects distant about an ordinary city block and a half quite distinct, and in this connection the inventor points out, it is the quality of the light rather than the quantity that is of greatest importance.

As already has been explained, the construction of the lamps is radically different from anything else of its kind, a fact which is made plain by the accompanying illustration and cross-sectional drawing showing the bulb and lens positions. The principle, be it added, is almost exactly akin to that of the side-walk projector, which a short time ago was in such vogue as an advertising medium.

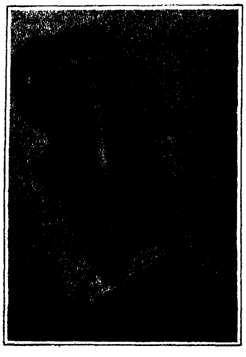
The body of the lamp is tubular and a fairly large mushroom-shaped tungsten bulb fits into an Edison socket at the bottom. A condensing lens is placed directly above the bulb and above that again there is a double combination projecting lens which directs the light against a French reflector set at the proper angle in the hood to reflect the beams through a plano-convex lens. The bulbs consume approximately four amperes when connected in parallel. A switch to connect them in series for city driving is provided.



The headlights may be secured to the radiator by means of long bolts.



Arrangement of the lens and reflector.



Added to the searchlight beam there is a widely diffused illumination.

In the tubular portion of the lamp body immediately surrounding the bulb and lens system, there is inserted a ground glass cylinder through which a soft, diffused light filters and partly illuminates the front of the car. Obviously, the amount of light diffused can be varied by altering the characteristics of the ground glass cylinders.

As the picture makes plain, the lamps are attached to the radiator of the car through the medium of long bolts running through it; owing to their lightness, it is stated that vibration can cause no harm to the comparatively delicate radiator. In another style, provision is made for attaching the lamps to the dash in the orthodox manner

A Far-reaching Trade-mark Decision

JUSTICE VAN ORSDEL of the Court of Appeals of the District of Columbia has handed down a decision in the Asbestone Company, appellant, versus the Philip Carey Manufacturing Company, appellee, patent appeal No. 885, in which he holds in a trademark opposition that where the name of an "individual, firm, corporation or association" is sought to be registered, the right of opposition is statutory; that proof of actual damage is not required, and that applicant need not be engaged actively in the business for which it was alleged it was incorporated; accordingly, he sustained the opposition

This decision will not only extend to opposition proceedings, but will open a new field for the rejection of trademark applications by the Patent Office as well as provide for the registration or entry either officially or otherwise of corporate names in the Patent Office so they can be utilized by the Patent Office as references against an application for registration. It is probable that it will be necessary for the corporation to file a certified copy of its articles of incorporation or some other certified evidence of its corporate existence, so the Patent Office can utilize the material as a reference

If the corporate existence is sufficient for purposes of opposition it is not going too far to say that it will also be a ground for cancelation proceedings. With the enormous number of commercial corporations whose titles or corporate names include high-class trademark matter, it is manifest the field of search by the Patent Office will shortly be greatly enhanced.

Coal Smoke as a Cause of Cancer was the subject of a paper presented by Sir William H Bennett at the recent Smoke Abatement Conference in London. Starting with some observations by C. E Green to the effect that there was a distinct relation between the occurrence of cancer and the kind of fuel used for domestic purposes, he detailed the results of investigations on this subject in Nairnshire, the Orkneys, and elsewhere The incidence of cancer was found to be limited to regions where coal was the staple fuel, whereas where peat was used, cancer was almost non-existent. The main exception to this statement is that a comparatively high cancer rate is found in certain peat-burning districts where the peat is a hard, black substance, burning with a long flame, not smoldering as does ordinary peat. A large sulphur content in the fuel is associated with the occurrence of cancer. The speaker pointed out that if these results were confirmed, they would form a terrible indictment of coal as an ordinary fuel.

The western lava bed in motion.

EVER since assuming my duties four years ago at this Kagoshima School, I have found Sakurajima to be a favorite subject of discussion among the citizens of this place. We had frequently imagined what would take place if the dormant volcano in the bay were to reawaken to the activity which it displayed in 1779, and always with some misgivings as to our fate if such a dread disaster were to occur. Ever since the eruption, vulcanology has been the only popular topic of conversation, and fortunately we have gained not a little knowledge from the visits of Dr. Omori and other scientists. It is my belief that a selection of this gossip will be of more interest to American readers than an eyewitness's chronicle

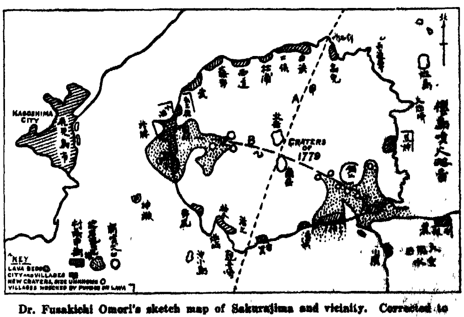
First of all, could the eruption be predicted? To this query I will say that it was, and it wasn't, foretold Dr Omori, who is a firm believer in the 60 to 65-year period of volcanic activity, has put himself upon record as having urged the purchase of a new seismograph upon the governor of this prefecture as early as last summer A bill for the $70 representing the cost of such a perfected instrument was voted down in the end, by a thrifty prefectural assembly As this year fell within the period of activity for the Kirishima, Sakurajima, Kaimondake volcanic chain, Dr Omori expected an unusual eruption at some point in the range Then again, as January 10th and 11th were marked by many earthquake shocks which continued up to the moment of explosion, the populace, especially the 21,000 Sakurajima islanders, were anticipating danger, at least a great quake On January 11th, the hot springs at Arimura village rose three feet and the water was unbearably hot. Smoke too, in fine lines invisible from Kagoshima city, was often noticed on this day, so that refugees first left the island at about 9 P M. on the night of the 11th. Not a few islanders and others were waiting for an eruption, although they could not bear to put their fears into words The head men of the various island villages frequently telephoned over to the Kagoshima Meteorological Station, but were always informed that the earthquakes were non-volcanic in character. At this point some one will say that common sense should have guided the weather prophets more wisely. But the truth seems to be that they pinned their faith firmly to the records of the antiquated seismograph at the observatory, and failed to discover the true center of the seismic disturbances. Hence, the eruption was vaguely anticipated by the best-posted scientists, and by the many islanders, all of whom escaped but two, yet it was not foretold by the weather observatory. In a sense, an imperfect seismograph must be condemned as affording no protection.

Then again Dr. Omori at Tokyo, and my colleague, Jira Sasamoto, Esq., lecturer on mineralogy, were both able to foretell the issue of the eruption which did take place on the 12th, and to declare that the city of Kagoshima would escape serious damage. These splendidly audacious and accurate prognostications were based upon an intimate knowledge of the geology of the island, and the fact that volcanic earthquakes are never very violent. Sakurajima is a much worn cone of andesite, soft at that, and covered with layers of tufa and volcanic ash which could not resist any great subterranean force without yielding. Again, the prevailing northwest winds which blow almost incessantly until April, offered an almost certain protection against pumice showers, etc. These gentlemen also knew that a tidal wave could not rise in such a deep and narrow passage (2 miles wide, 80 fathoms deep) as that which separates Kagoshima from Sakurajima unless the mountain were to drop into the sea almost instantaneously. An old volcano like Sakurajima would not be likely to do this.

Prof. Sasamoto was consulted by the local authorities on the day of the eruption, and his conclusions were widely posted up in the city, but his influence could not stop one of the most remarkable panics in history. A professor of psychology is said to have come 900 miles from Tokyo to investigate the mob psychology of this flight. The eruption began at ten in the morning, and with very little noise, the craters on the far side coming into activity at almost the same moment, and though a few people fled by eleven, a large number waited until about three in the afternoon, and then left without making any preparations at all. This was because the mountain was then entirely veiled in fog and ashes, and hence the volcano seemed more terrible. But at least two thirds of the population remained in their houses until 6:35 P. M., when an earthquake of considerable violence caused some small damage to every house in the city and drove out the population under the scourge of fear—fear of earthquakes and tidal waves.

This earthquake shock was felt with equal violence along the projection of the line *B* running northwest and southeast in the map. Owing to the soft volcanic rock which is alone available for building purposes in this neighborhood, stone walls were much injured, especially when they lay north and south, at right angles to the shock. This, strange to say, was the only notable earthquake that took place.

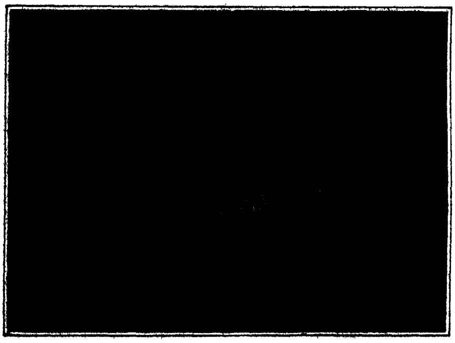
A Japanese friend once remarked to me that it was impossible to run from



Dr. Fusakichi Omori's sketch map of Sakurajima and vicinity. Corrected to February 4th, 1914.

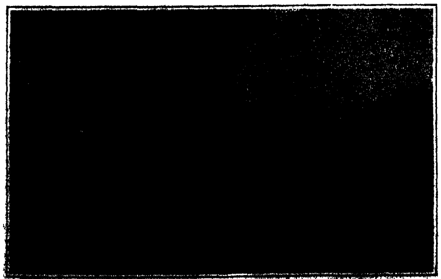
A. Line of the Kirishima, Sakurajima, Kaimondake volcanic chain. *B.* Line of the Ijuin Fault. (Earthquake felt with greatest force.) At the extreme left, Kagoshima city. Opposite are the villages indicated by Japanese characters which have been wrecked by pumice or buried under lava. These are, from northwest to northeast, Akabubara, [illegible], Yokoyama, the island of Karasujima, engulfed, Arimura, Seto, Ushine on the mainland, and Kurokami to the north. The lava-flow from the southeast craters has connected the island to the mainland.

The western and eastern craters on January 24th. Steaming lava is seen low down in the right-hand corner



View of the eastern lava beds covering the site of the village of Arimura, southeastern Sakurajima. The lava has been bifurcated, as shown from the map on the previous page, by the small knoll to the left

Ushine village on the mainland. This picture was taken amid thickly falling ashes so that distant points are not seen. The village homes are visibly covered with volcanic deposit



The eastern craters and the ash-buried village of Kurokami.

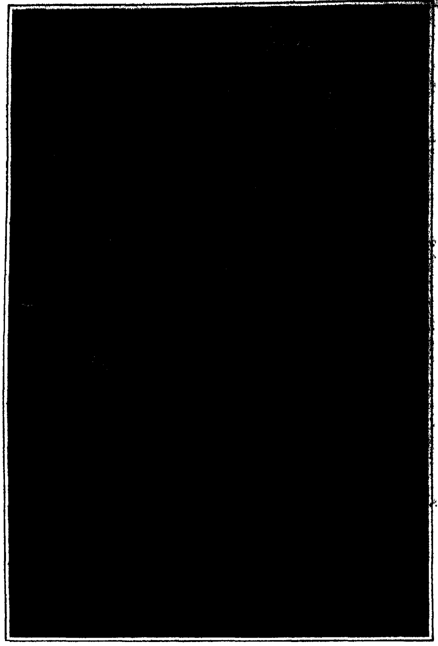
Sakurajima dormant Photographed from the hills behind Kagoshima.

danger in battle but that it was his duty to leave his house in an earthquake Among the refugees there was no wailing and no fainting of women such as might occur elsewhere but these people did not need to shout or discuss their plans, they were all mastered by the one thought of their personal safety Yet there was little selfishness and on that day none of the last courage born of avarice no pilfering And those people who determined to stay after the earthquake were gradually driven off by appalling electrical phenomena that increased during the night, or else warned to leave the city by the police and soldiers who came in boldly to watch over the deserted city It seems very doubtful if one thousand persons out of a population of 70 000 spent the second night of the eruption within two miles of the city

As to the characteristics of the eruption it was pre-eminently an ash eruption at first The force of the explosions was not great yet as there was so little resistance ash and clouds were carried to at least 20 000 feet and the eruption seemed to be more violent than it was and very short-lived since there was no check upon it On the other hand no glass whatsoever was fractured The electric displays were unbearable and the thunder deafening However there was almost no moisture, only a heavy thunderstorm of three hours on the second night that affected all of the island of Kyushu Since this time there have only been two short rainfalls Hence the skies were not obscured owing to the wind and the moonlight was a great comfort to the refugees On the other hand, the lava flow has been unusually great for a Pacific Ocean volcano in the modern period

Lava began to flow about 8 o clock on the evening of the 13th the most spectacular moment of the whole eruption and continued to flow from the western craters until January 26th On Monday January 19th the island of Karasujima was engulfed in this bed and even as late as January 24th the whole bed was advancing at the rate of a foot an hour in Dr Omori s opinion The photograph shows how rocks would roll down from the crest of the lava beds as they were pushed forward The area of the two lava beds was then estimated as totaling 10 square kilometers with an average thickness of 50 meters, making the amount of lava then emitted reach 7 cubic kilometers On the eastern side the craters are still exceedingly active, and lava continues to flow The channel between Sakurajima and the mainland has been entirely filled converting the island into a peninsula and blocking the fairway for the steamers which used to make the circuit of the island

The injury wrought by the volcano has not been confined to the island, but is very wide in those districts of Kagoshima prefecture lying to the southeast and hence still suffering from such constant showers of ashes that no photographer has been able to get clear pictures of the affected area. We are truly thankful that their loss has been our gain and that it is possible to flatly contradict the absurd telegraphic reports which first heralded the eruption to an astonished world

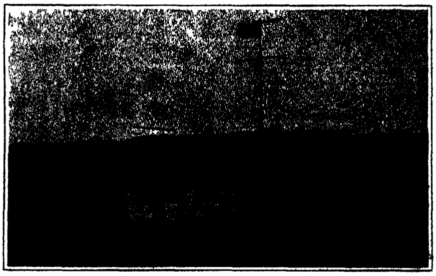


Trees stripped of leaves and houses buried under fall of rocks and ash at Kurokami village, eastern Sakurajima. The pits seen in the photograph are caused by the collapse of the houses located here.

Wireless Detection of Wireless Criminals

By V. Ford Greaves, United States Radio Engineer

A WIRELESS detective is maintained by the United States Bureau of Navigation to patrol the waters along our Atlantic coasts to trap the radio practical joker who sends out false S O S messages, to locate the station that does not observe the prescribed wave-length regulations and in general to see that order is maintained in circumambient ether This detective the motor boat Tarragon was originally designed to act as policeman for motor boats and make them observe the navigation laws Now it has been equipped with a very efficient radio apparatus in charge of U S Radio Inspector Benjamin F Wolf, and will enforce the radio laws of the United States and the London International Radiotelegraphic Convention along the Atlantic Coast.



United States patrol that enforces wireless laws.

The radio apparatus was designed and assembled under the direction of Mr. Frederick A Kolster of the Bureau of Standards Its special features are compactness and facility for quick change from one transmitting wave-length to another. The transmitting apparatus and motor generator are all mounted on a panel-board 22 inches wide by 30 inches high, as a single unit The apparatus on the back of the board projects a maximum distance of 18 inches The motor generator is operated by 20 Edison cells, which will operate the apparatus continuously on full load for about eight hours on one charge The cells are charged by a small auxiliary gas engine direct connected to a 35-volt, 35-ampere generator The spark-gap is of the quenched type A break system relay enables the operator to be "broken" or to overhear any interference while transmitting At present the normal wave-length of the "Tarragon is 300 meters. In addition to this, transmitting wave-lengths of 200 to 450 meters are provided for The change from one wave-length to another is accomplished by a single throw of a six-point switch mounted on the panel board This single operation tunes both the oscillating and open circuits to resonance, and with a slight variation of coupling, maximum radiation is obtained The wave-length change device and the method of varying the coupling are very ingenious, and were devised by Mr Kolster The receiving apparatus is secured to a bulkhead, and the operating table upon which is mounted the transmitting key folds down when not in use The complete installation occupies very little valuable space, even considering the comparatively small size of the ' Tarragon."

The installation is rated at one quarter kilowatt, and on the 300-meter adjustment delivers a little over 3 amperes in the antenna. The antenna is necessarily of the comparatively inefficient inverted V type on account of the single mast available. The maximum height above the water line is about 27 feet and the natural period of the antenna about 60 meters

A test of the apparatus was conducted while the Tarragon ' was in the vicinity of Norfolk, Va The ' Tarragon" was able to plainly hear the time signals and weather report from Arlington and the same report repeated by the Key West Naval Station The press messages from Sayville, L. I., were also copied Communication was established over a thickly-wooded country a distance of about 35 miles with the Norfolk Navy Yard Station This indicates that the equipment has an approximate transmitting range at sea by night of 150 miles and that the Bureau of Navigation may communicate with the vessel by wireless telegraphy wherever she may be along the Atlantic Coast

Comparing the results of this test with those obtained by the average commercial shipboard station rated at one kilowatt and showing an antenna current of from 3 to 5 amperes and having efficient inverted L antennæ from 60 to 125 feet above the water line it is concluded that the 'Tarragon s' radio equipment is extraordinarily efficient

Radio apparatus of the motor boat "Tarragon."

Interpreting Claims—In Hall Mammoth Incubator Company vs Teabout (U S D C) District Judge Ray, citing Winans vs Denmead (15 Howard 330) said "Unless there are limitations written into the claim, or imposed by the prior art, or by acceptance of a narrow claim in place of a broad one, in the Patent Office, in order to secure the patent, the inventor is entitled to every form in which his invention may be copied and to a broad construction." Also that "Hall elected to locate his levers and connecting rods, etc., where and as he did and to claim specifically all the several parts and cannot ask the Court to modify or rewrite his claim by ignoring any claimed element of his combination. He asserted their materiality by claiming them, and cannot be heard to deny it."

A New Way of Detecting Art Forgeries

The Microphotographic Study of Brushwork

By Prof. A. P. Laurie, Hewitt-Watt College, Edinburgh

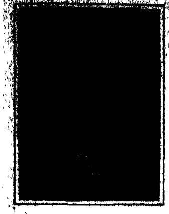


Fig. 1.—Microphotograph of head in a Watteau. No. 55 in Edinburgh National Gallery.

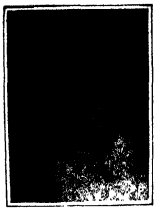


Fig. 2.—Microphotograph of the head shown in Fig. 1, but from the copy of Watteau shown in Fig. 5.

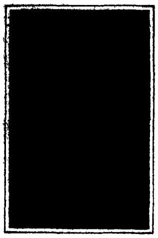


Fig. 3.—Microphotograph of face from a Pater. No. 60 in Edinburgh Collection.

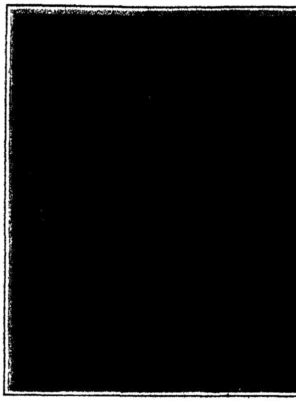


Fig. 4.—A representation of a genuine painting by Watteau. (No. 55 in the National Gallery of Edinburgh.)

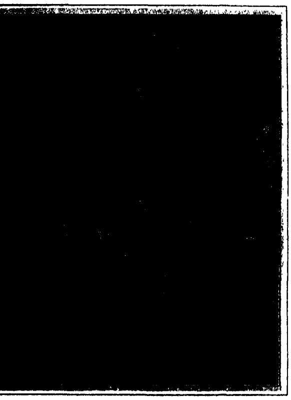


Fig. 5.—Copy of the Watteau No. 55, which is apparently handled quite in the manner of the master.

Fig. 6.—Head of old man by Teniers. No. 817 in London National Gallery.

FOR some time I have been engaged in a series of researches, with a view to applying scientific methods to the identification of pictures and the exposure of forgeries. In the first place I began by making a careful investigation into the history of pigments with a view to deciding at what dates certain pigments were used in the history of painting, as it is obvious that if we have a knowledge of this, we can very often approximately date a picture, and so decide whether it was painted at the period to which it has been assigned. These investigations were carried out by the study of dated documents, such as Illuminated Missals, Venetian Ducali, and the Coram Rege Rolls in the Record Office, London, which are illustrated with miniatures from 1500 to 1700.

By means of these dated documents it has been possible to construct a fairly complete history of pigments, and to state very definitely when certain pigments came into use and other pigments ceased to appear upon the artist's palette. In addition, I have devoted considerable attention to the microscopic study of the surface of pictures, with a view to detecting repainting and identifying the pigments in position, and also to the microscopic identification of pigments, enabling one to deal with the very tiny samples which can be removed without injury to the picture.

These methods, then, enable one to decide whether the picture is a modern forgery, whether repainting has taken place, and also to date the picture itself approximately In addition, it has been found that certain artists are accustomed to use certain pigments, so that the probability of a picture being by a given artist is strengthened if the pigment which he generally used is found upon it. It was while making these researches that I was struck with the amount of information which could be derived as to the painting of a picture, from the careful study of the brushwork suitably magnified. It is, of course, customary for all art connoisseurs to use a magnifying glass, but the information to be obtained is very much more reliable and useful if, instead of using the magnifying glass, careful microphotographs are taken of selected portions of the picture under examination.

In order to get successful results, the enlarged photograph should be taken directly on to the negative, the amount of enlargement depending on the style of the brushwork of the particular artist. As a rule, about three diameters are sufficient, but there are cases where enlargements up to as much as six diameters are of value for this purpose. By means of these photographs one is able to isolate the facts of brushwork without any confusing considerations, and one is able to compare side by side a series of such microphotographs.

Supposing, for instance, a picture is believed to be by a given artist, microphotographs of selected portions are taken and these are compared with microphotographs of pictures of undoubted authenticity by the same hand; while, if there is some other artist whose name is suggested as a possible author of the picture, microphotographs are also taken of his work, for comparison. In this way it is possible, in the case of a very large number of painters, to arrive at very definite conclusions. There are schools of painting, of course, which do not lend themselves to these methods, but, on the other hand, there are many artists whose individuality of brushwork is so marked and so characteristic as to make imitation impossible. The copyist or the pupil may imitate a master's general style, but each man has his own way of laying on the paint which is characteristic

During the time I have been investigating this method, I have been accumulating typical microphotographs of the brushwork of many of the great masters, and every day one is learning something new as to their methods, and also as to how far a man's brushwork varies, and how far certain characteristic touches remain throughout his career.

In the case of the painters of small pictures with minute figures, such as Teniers and Watteau, microphotographs of the whole of the face are usually most useful, and the enlargement may extend to five diameters on account of the minuteness of the brushwork employed by these artists. In the case of the life-size portrait painters, it is necessary to select some portion of the face into which the artist has put the greatest amount of careful work. On the whole, the eye usually gives the most information, magnified some three diameters In the case of landscape artists, the painting of foliage is usually very characteristic. At the same time, it is usually advisable to examine the picture very carefully with a view to seeing whether there is not some piece of rapid and characteristic painting on which the artist, working very freely, has shown his peculiar methods. In the case of Velasquez, for instance, it is often found in some portion of the painting of the figure itself—a piece of drapery or a tassel or a bit of embroidery being painted in with a rapid and characteristic hand.

There are also obviously certain dangers in an investigation of this kind, owing to the fact that so many of the great artists employed their pupils to do the less important parts of their painting, and therefore we must not be led astray by assuming the work of a pupil to be the work of a master. It is for this reason that, as a rule, it is safer to compare the more important parts of the painting

From the large number of photographs which I have made, I select one or two typical examples, in order to illustrate the various points. The

(Concluded on page 240.)

Fig. 7.—Brushwork of the "Spanish Admiral," which is attributed to Velasquez.

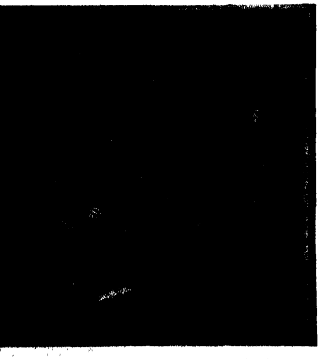


Fig. 8.—Brushwork in the portrait of Philip IV by Velasquez.

The Storm of March 1st, 1914, Measured in New Units

By Alexander McAdie, Director Blue Hill Observatory

IN various recent issues of the Scientific American reference has been made to the desirability of recording meteorological conditions in more rational units than those of the old scales. In the Scientific American Supplement for December 6th, 1913, there is described in detail the new methods of representing atmospheric pressure variations in per millages (or percentages with an added decimal) of a standard pressure

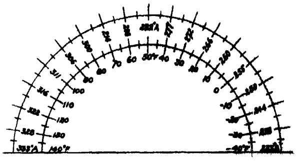
It may not be out of place to restate briefly the essential features of the new notation. First, temperature is recorded on the absolute Centigrade scale, the zero being that of the hydrogen gas thermometer, or practically 273 degrees below the zero of the Centigrade scale thermometer. We thus say "good-bye" to the Fahrenheit scale, which, serviceable for many years, has, however, now outlived all usefulness, and is practically discarded in all scientific work It may be recalled that originally this scale ran from —90 degrees, mixture of salt and ice, to + 90 degrees, the temperature of the human body, the whole making 180 degrees Later Fahrenheit made the zero of the scale the lowest temperature of the winter of 1709 in his country, 32 degrees the temperature of melting ice and 212 degrees the temperature of boiling water under constant pressure. The other scales, Reaumur's, Celsius, and Linnæus's modification of the Celsius (the modern Centigrade) may also be relegated to the past

The new zero is that of the hydrogen gas thermometer. Here the temperature is directly proportionate to the pressure There is a temperature scale known as the absolute energetic or thermodynamic scale in which the ratio of any two temperatures is equal to the ratio of the heat absorbed at the one temperature to the heat evolved at the other when heat is transferred by any reversible cyclical process whatever. Unlike gas or mercury thermometer scales, the definition of temperature does not here involve a relation to any property of any definite substance Temperatures expressed in this scale are proportional to the pressures given by a constant volume thermometer filled with a perfect gas There is very little difference between the two scales, and while there are some uncertainties in connection with the absolute zero itself there is no great error in making the zero 273 deg Cent below the temperature of freezing water For ordinary atmospheric values, we have as given in Fig. 1

In the storm of March 1st, contrary to expectation, there were no marked changes in temperature. The record at the observatory, 195 meters above sea-level, shows a gradual rise from 273 deg A to 280 deg A The record at the base station, 64 meters elevation, is practically the same There were no abrupt rises or falls. At the lower level it was colder from 4 A M until 6 A. M. than at the summit About 8.30 P M. the temperature fell about five degrees, the fall occurring at the higher level about twenty minutes in advance of the lower. Unfortunately there are no records available for various levels in the free air The wind did not shift as expected and the path of the storm was evidently somewhat west of north rather than to the east. From 2 A M. until 2 P M the wind was east-southeast, then backing to east and remaining so until 8 P. M., when it veered to southeast, notwithstanding this was the time of lowest pressure. The maximum velocity occurred at 6 30 P. M , 27 5 meters per second, equivalent to 33 meters per second (74 miles per hour) in the uncorrected velocities used by the Weather Bureau. At the time of lowest pressure, 7 35 P M, the velocity was 27 meters per second, decreasing gradually until 10 P. M. and rapidly after that. With such a marked pressure fall higher velocities might have been anticipated. On February 10th, 1909, a velocity of 32 meters per second (84 5 miles per hour, uncorrected) occurred

The total rainfall was 34.5 millimeters, and there were no unusual features either of intensity or duration. The relative humidity throughout the whole period was 100 per cent

The feature of the storm that was remarkable was the fall in pressure (Fig. 2) The lowest reading recorded in the history of this observatory (twenty-nine years), and possibly the lowest in Weather Bureau records for this part of New England (forty-four years) occurred. In the old notation the reading would be 27.80 inches (28 47 inches at sea-level). Those familiar with weather charts know that any reading below 29.00 inches is low, but even to professional meteorologists the figures do not convey a clear cut conception of the value of the fall and the significance of the reading. In the new system (see pressure charts) the reading is 941 kilobars If we take 1,000 kilobars as the standard pressure or absolute atmosphere then one sees at a glance that there was a fall of 59 kilobars, or 5.9 per cent. Suppose we call it 6 per cent of an atmosphere. If the height of the homogeneous atmosphere is approximately 8,000 meters we know at once that the storm caused the same decrease in pressure that a rise of 480 meters would give. Again, it is very simple to determine the gradient either with respect to distance or time. Thus at 2 P. M. the pressure was 961 kilobars, and at 8 P. M. 941. The difference, 20 kilobars in six hours, is in units of absolute force 20,000 bars, the bar in this case being the absolute unit of pressure. We thus have (what has long been desired) a C. G. S. atmosphere, and the values of all readings are easily comparable with other pressures, from that of ten atmospheres to the feeble pressure of radiation.



Convenient conversion scale, temperatures F. to A.

In the Scientific American Supplement for October 25th, 1913, Mr. A. F. Miller has given a very interesting computation of the equivalent weight of the air displaced in the marked storm of January 3rd, 1913. He takes as the extreme pressure readings 30.30 inches and 28.30 inches. In the new system these would be 1,026 kilobars and 958 kilobars, and the difference 68 kilobars In the old system, after some figuring and likelihood of error, one computes that over every 2,000 square inches the reduction in pressure would about equal the removal of one ton of air. In the new system one knows at a glance that the reduction was 6.8 per cent of the normal pressure whether expressed in units of weight or of force

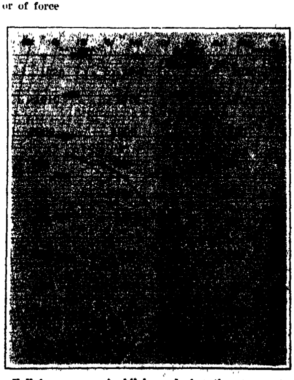
BASE PRESSURE 1,000,000 DYNES OR 1,000 KILOBARS.

Pressure in kilobars = 1,000 +.

Barometer in inches.	.00	.02	.04	.06	.08
29.00	— 18.0	— 17.3	— 16.6	— 16.0	— 15.3
29.10	— 14.6	— 13.9	— 13.2	— 12.6	— 11.9
29.20	— 11.2	— 10.5	— 9.9	— 9.2	— 8.5
29.30	— 7.8	— 7.2	— 6.5	— 5.8	— 5.1
29.40	— 4.4	— 3.8	— 3.1	— 2.4	— 1.7
29.50	— 1.1	— 0.4	+ 0.3	+ 1.0	+ 1.7
29.60	+ 2.3	+ 3.0	+ 3.7	+ 4.4	+ 5.0
29.70	+ 5.7	+ 6.4	+ 7.1	+ 7.7	+ 8.4
29.80	+ 9.1	+ 9.8	+ 10.5	+ 11.1	+ 11.8
29.90	+ 12.5	+ 13.2	+ 13.8	+ 14.5	+ 15.2
30.00	+ 15.9	+ 16.6	+ 17.2	+ 17.9	+ 18.6
30.10	+ 19.3	+ 19.9	+ 20.6	+ 21.3	+ 22.0
30.20	+ 22.6	+ 23.3	+ 24.0	+ 24.7	+ 25.4
30.30	+ 26.0	+ 26.7	+ 27.4	+ 28.1	+ 28.7
30.40	+ 29.4	+ 30.1	+ 30.8	+ 31.5	+ 32.1
30.50	+ 32.8	+ 33.5	+ 34.2	+ 34.8	+ 35.5
30.60	+ 36.2	+ 36.9	+ 37.5	+ 38.2	+ 38.9
30.70	+ 39.6	+ 40.3	+ 40.9	+ 41.6	+ 42.3
30.80	+ 43.0	+ 43.6	+ 44.3	+ 45.0	+ 45.7
30.90	+ 46.4	+ 47.0	+ 47.7	+ 48.4	+ 49.1
31.00	+ 49.7	+ 50.4	+ 51.1	+ 51.8	+ 52.4

Example: Barometer reading 29.62 inches, convert to kilobars. Tabular correction for 29.60 + 0 02 is + 3 0 Pressure in kilobars is 1,000 + 3.0 = 1,003.0.

A convenient conversion table for pressure in kilobars. (Prepared at Blue Hill Observatory.)



Fall in pressure in kilobars during the storm of March 1st. This is the first record of pressure in kilobars ever published.

Prevention of Mine Explosions by Stone Dust

RECENT elaborate experiments by English scientists show that the presence of considerable stone dust in coal mines tends to quench the combustion of "fire damp" and coal dust. This important work points the way to prevention of a large proportion of mine explosion, and it is to be hoped that the method will be tried out in all countries, and developed into the maximum efficiency.

It is universally agreed now that a mixture of coal dust and air is just as explosive as a mixture of fire damp or methane and air. The same is true of flour mill explosions, undoubtedly caused by the ignition of a favorable mixture of air and floating flour dust.

To understand clearly the preventive effect of stone dust, one must consider the mechanism of the reaction between two gases capable of combining with each other. When the temperature of part of the mixture is raised to the ignition point a few molecules unite first, but the heat produced by their union is at once dissipated through the remaining molecules. Of course if the entire mixture is suddenly raised to the ignition point by external heating the combination may be instantaneous and explosive, but if only a small portion of the gas mixture be heated the action takes place in two stages. The heat given to surrounding molecules by ignition at the initial point will cause them to unite if the mixture is right, and thus the flame will spread. As the flame spreads, however, the general temperature and pressure is raised to a point where practically all the molecules in contact unite instantly—the "explosion wave."

In a mixture of methane and oxygen there must be at least a definite percentage of methane to insure ignition. Less than that much methane in the mixture will not unite. With just this minimum percentage of methane a spark or glowing wire will cause combustion of the methane and oxygen on its surface, but the flame will not spread and no explosion will result. The point is that the heat of combustion is carried away by the excess of oxygen molecules. Excess of nitrogen or any inert gas would cool the flame in the same way.

With floating coal dust the mechanism is similar. A small flame from any source heats a little dust to the point of distilling off coal gas which forms an easily inflammable mixture with the air. The flame thus propagated heats the remaining dust and air to such a temperature that the intensity of molecular contacts insures almost complete and instantaneous combustion with explosive violence. The speed of this propagation of flame is enormous. Wheeler and Darwin measured it in one case as 1,300 miles an hour. The presence of suspended coal dust is accounted for by the jarring effect of the flame wave from an initial gas explosion. Thus a small methane explosion might be so in effect as to do little damage, but with plenty of coal dust in the galeries to be jarred into the air, the explosion may be carried throughout the mine. The problem is to dilute all possible explosive mixtures with inert materials, gaseous or otherwise, so that impacts between active molecules will be lessened and the flame cooled so that it cannot travel. Crushed shale, limestone or fuller's earth act in this way. It was once thought that such dust particles aided the flame catalytically, but experiments in England have proved beyond doubt that inert dust in the mine actually retards explosion.

It is worth noting that in the presence of a flame, coal dust, and air, the first action is distillation if the coal is bituminous, and second the burning of the gas so formed. After this flame runs some distance the oxygen molecules seem to hit the dust particles so violently that there is instant burning of the dust particles as a whole without further distillation. The preliminary slow burning followed by gradually increasing velocity and pressure and finally high pressures and great oscillations of flame are characteristic of both fire-damp explosions and coal-dust explosions. An initial fire-damp explosion may set off anthracite dust or even charcoal dust.

It is urged that care be taken to use only such stone dust as will not injure the lungs of miners. Obviously powdered quartz would not do. Also the dust must be applied as often as it becomes overlaid with a fresh deposit of coal dust of any appreciable thickness. Of course the heavy stone dust cannot be kept in the air ready for emergencies, but that is not necessary. As soon as an explosive wave reaches the stone dust, enough of it is thrown into the air to cool the explosive mixture below the burning point.

C. G. S. Units of Barometric Pressure

THE British Meteorological Office has decided to take the radical step of adopting the C. G. S. units, centibars and millibars, in place of the familiar inches of mercury in all its barometric measurements (instead of merely in its upper-air observations, as heretofore). Beginning May 1st, 1914, the new units will be used on the British daily weather maps, isobars being drawn for each half-centibar.

[illegible] PATENTED INVENTIONS

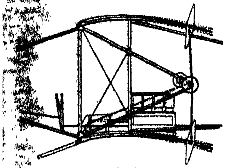
[illegible] columns are open to all patentees. [illegible] are inserted by special arrange[ment] with the inventors. Terms on applica[tion] to the Advertising Department of the [Scien]tific American.

Pertaining to Apparel.

[illegible]—CHARLOTTE MACDONALD, care of Edward Macdonald, Ossining, N. Y. This [inven]tion provides a corset having a plurality [of] vertical members, which are connected by [a plur]ality of horizontal elastic members, se[illegible] the vertical members, the horizontal [illegible] free from adjacent elastic members, [illegible] the vertical members, so that [illegible] ones may act independently of [illegible]er. The corset gives the greatest [illegible] of movement, and especially it is [illegible] for women engaged in athletic pas[illegible]

Pertaining to Aviation.

[AERO]PLANE.—D. M. CALHOUN, Clarks, La. [This in]vention relates particularly to a form [illegible] in monoplanes or biplanes in which [the fro]nt portion is essentially rigid and non-[vibrati]ng, while the rear portion is vibratory [and ha]s connected therewith a vibrator to im[pa]rt [illegible] and rapid vibrations in a vertical [illegible] The vibratory rear portion of the plane [is cont]iguous with the rigid front portion, so that the upper and lower surfaces of the com[ple]te plane are continuous, while the rear por[tio]n, which is flexible, constitutes in effect, a [illegible] propeller. The plane preferably is [cu]rved, the curve decreasing toward the rear. Vibrating of rear portion of the plane may [ex]ert a propelling force auxiliary to that of known propellers, or may be utilized alone as a propelling means.



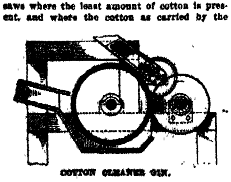
AEROPLANE.

Of Interest to Farmers.

CHICKEN ROOST.—F. SCHARDT, Arapahoe, Neb. The object of the inventor is to provide a device wherein a roost is provided, upon which the fowls may perch, and means in connection with the roost for containing chemicals or the like for destroying vermin on the fowls, and so arranged that when the perch is unoccupied, the chemical containing means will be closed, and will be opened to permit the medicinal agents to escape when the perch is occupied by the fowls.

CHICKEN ROOST.

COTTON CLEANER.—E. A. ROSIER, Sparta, Ga. The purpose of this device is to comb, card or clean cotton while the latter is passing through the gin and is being carried by the gin saws at points in the rotation of the saws where the least amount of cotton is present, and where the cotton as carried by the saws offers the least resistance to motion of the saws. By the use of the apparatus the color and general quality of the cotton are greatly improved, the cotton operated upon being as a consequence entitled to a higher grading. The engraving shows a vertical section through a gin equipped with the invention.

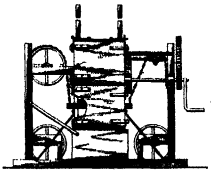


COTTON CLEANER GIN.

TRACTION WHEEL FOR PLANTERS.—E. [illegible], [illegible] North [illegible] St., Springfield, Ill. This invention relates to traction wheels for corn and other planters. It provides a traction wheel which will straddle the hills of corn [illegible]. A further object is to provide a wheel with means which will effectually prevent it from slipping.

GRAIN TESTER AND SEED SEPARATOR.—A. C. ENGELSTAD, Aylesbury?, Canada. This invention provides a portable device by means of which seeds or grain have practically the same specific gravity. Thus the device may be used for separating wild from cultivated oats. The device is made in sections and readily taken apart to permit access to the seeds which are so separated.

BALING MACHINE.—C. F. UECKE, New London, Wis. This invention is an improvement in baling machines, and has for its object the provision of a machine for compressing any desired material, as for instance, cotton, hay or the like, wherein a pressing chamber is provided, and a plunger movable in the pressing chamber, together with means for permitting the plunger to be moved manually. The accompanying engraving presents a front view of the improved baling machine.



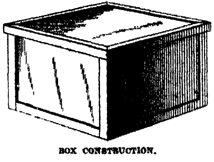
BALING MACHINE.

Of General Interest.

MANUFACTURE OF ARTIFICIAL SILK.—H. TIMPE, Weesperzijde No. 125, Amsterdam, Netherlands. This inventor employs as a starting material the protein substances which remain in cows' milk after the same has been reacted on by salts of pyrophosphoric acid or pyrophosphates, and the casein precipitated thereby has been removed therefrom. These protein substances are then thrown out from the whey, and by certain means by which the finest elastic silk-like threads may be produced of great strength and toughness and adapted for all purposes where silk is employed.

MANUFACTURE OF PRODUCTS FROM INDIA-RUBBER.—H. DOGNY, 13 Ave. d'Eylau; V. HENRI, 82 Rue Claude Bernard; and E. VEIL-PICARD, 76 Ave. Wagram, Paris, France This invention refers to improvements in the manufacture of products from India-rubber or other suitable resilient material of the kind composed of either perforated sheets or perforated and unperforated sheets of such material, which are united together and have the cavities so formed filled with gas or air whereby a pneumatic and resilient structure is obtained.

BOX CONSTRUCTION.—O. W WARD, 96 Fifth Ave., Manhattan, N. Y, N. Y. This improvement relates to the construction of cheap strong articles such as stands, taborets and the like, and also to the construction of storing and shipping devices such as hat boxes, etc. It provides means whereby devices of this character may be quickly and accurately assembled which permit a neat and ornamental appearance, the same having also the capability of being knocked down or taken apart for purposes of storing away in small places or for shipment empty.



BOX CONSTRUCTION.

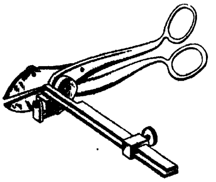
NON-REFILLABLE BOTTLE.—I. D. KELLET, 1178 Jackson Ave., Bronx, N. Y., N. Y. This invention relates to bottles, jars, etc., in the neck of which there is arranged mechanism serving to permit the outflow of liquid, but preventing an inflow of liquid. An object is to improve this class of devices whereby a container will be rendered practically non-refillable by the use of simple and reliable means.

BUFFING OR POLISHING WHEEL.—G. P. KELLER, 418 W. 27th St., New York, N. Y. This wheel is formed of a plurality of folded pieces of muslin or other fabric material. It is arranged to prevent the peripheral face of the wheel from unraveling and thus insuring long life of the wheel, and to allow using the wheel until the fabric pieces are practically used up.

Hardware and Tools.

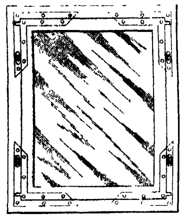
COMBINATION TOOL HOLDER.—W. L. HANE, Ocala, Fla. Mr. Hane's invention is an improvement in combination tool holders, and has for its object the provision of a simple, inexpensive holder of the character specified, for use with lathe planers and shapers, and wherein the holder may perform a plurality of functions, thus resulting in economy in both time and labor.

SHEARS.—C. F. ZIMMERMAN, Jersey City, N. J. This invention relates to shears for cutting sheet metal or for other like purposes; and has reference more particularly to shears comprising a member consisting of a blade and a handle, a second blade pivotally mounted upon said member and having an extension pivotally connected with said second blade. It also relates to the combination of shears and a gage foldably associated therewith and having means for locking the gage in an operative position, the gage serving adjustably to determine the length of material to be severed.



SHEARS FOR CUTTING SHEET METAL.

HANGER FOR SLIDING SASHES.—F B MASLEN, Moberly, Mo. This invention has for its purpose the provision of a hinge for connecting the frames and so arranged as to permit the complete detachment of the frames or the detachment at either side of the said frames to permit the said frames to swing with respect to each other In use, either side of the frames may be released to permit the frames to swing with respect to each other, and both sides of the inner frame may be released, if desired, for removing the said frame to clean it or for any other purpose



HANGER FOR SLIDING SASHES.

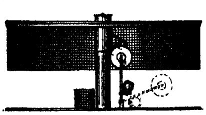
Household Utilities.

HOLDER FOR ICE CREAM FREEZERS.—F. HOSTETTER, 8905 Third Ave., Bay Ridge, Brooklyn, N. Y. Means provide for holding the freezer while the cream is being frozen, and the invention provides a holder in which the freezer may be firmly clamped in position and provided exteriorly with folded foot-boards on which the operator stands, or on which he may place a chair so that his weight will be availed of in the most effective manner in preventing movements of the holder and freezer

WINDOW CLEANING PLATFORM.—H. BOTTJER, 631 Classon Ave., Brooklyn, N. Y Among the principal objects of this invention is to provide a platform which may be adjusted to fit any ordinary size of a window and which will be strong and reliable when used in any position of adjustment with respect to the size of the window.

Machines and Mechanical Devices.

ANIMAL TRAP.—J. DE ST. LEGIER, 1st St., Hicksville, N. Y. This device is arranged so as to provide access to the trap from any direction when in set position, and to trap an animal alive and without danger of injury to its valuable fur or feathers Use is made of a base provided with upwardly-extending guiding means, a bottomless cage mounted to slide up and down on said guiding means, a supporting and releasing device for supporting the cage bodily a distance above the said base and for releasing the said cage to allow the latter to drop down onto the base, and locking means for locking the cage in trapped closed position.

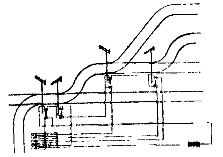


TRAP FOR BIRDS AND MAMMALS.

CARD EXHIBITING DEVICE.—H. W. HELLIKER, 1271 Tenth St., Oakland, Cal. This invention relates especially to devices for holding and exhibiting cards or the like. The particular object is to provide an exhibiting device for cards for use in connection with certain game apparatus made the subject of a previous application filed by Mr. Helliker, Serial No 730,163, and allowed April 8th, 1913, and of which this application is a division

Railways and Their Accessories.

SWITCH INDICATOR.—C. M. ROE, 315 Webster Ave, Jersey City, N J More particularly this invention relates to a means for indicating to the train engineer the position of the several switches to which he is approaching It is of advantage, in approaching a terminal, to know just what track of the terminal the engineer is coming into and be able to tell ahead of time just what curves and switches he is supposed to take This invention indicates to the operator, in entering the yard or the limits of the terminal, just what track is open to him



SWITCH INDICATOR.

BLADE FOR RAILWAY SWITCHES.—M GRIMALDI, mechanician, Rome, Italy In this patent the invention has reference to a blade for railway switches and consists substantially in that the heel of the blade is revoluble around a pivot which is carried by a support movable upon a slide plate As soon as a car has passed a switch, the blade resumes its normal position

Pertaining to Vehicles.

SPRING WHEEL FOR VEHICLES.—W J. LUTTRELL, Honey Grove, Texas In this invention the improvement relates to wheels of that type consisting of an inner and an outer section of annular form, with spring cushioning devices between the sections for use in insuring easy running of the vehicle by the spring devices absorbing shocks and vibrations.

ROAD VEHICLE WHEEL.—S H COPE, *Alma Street, Aston, Birmingham, England.* This invention has for its object the construction of an improved motor or other road vehicle wheel, of the type in which a detachable rim is employed, said rim having a radially or laterally movable segment for facilitating application and removal of the tire to and from the rim

WHEEL GUARD.—WILLIAM C PIGGOTT, London, England The guard comprises a depending guard member in the form of a leaf spring mounted in front of the front or back road wheel above the road surface, with facility of rearward, upward and preferably lateral movements, on the front wheel stub or movable axle or other part of the vehicle so that the guard member will, under normal conditions, remain in front of its wheel

Designs.

DESIGN FOR A LAMP SHADE.—L C TIFFANY, *care of Tiffany Furnaces, Corona*, L I., N Y This ornamental design for a lamp shade is in bell shape, the attractively uneven surface of the shade comprising a highly original and beautiful composition in plant life

DESIGN FOR A SET OF POLITICAL PLAYING CARDS.—M S. OLSEN, Box 558 Minot, N. D The faces of the cards employed in this ornamental design bear the party names Each card is embellished with the party emblems of heads, flags, mottoes, etc., and are numbered

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NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper

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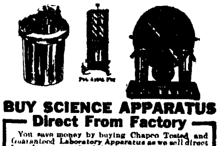

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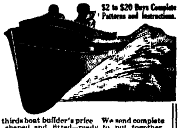

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(Concluded from page 232.)

incased and decked over like all of the car, which shows also general stream-lines, and has a pretty, windowed observatory with a searchlight in its nose. A machine gun is to protrude through a gun port in the side—rather an antiquated practice. The engine room in the center contains auxiliary machinery—a ventilator for the ballonets, and dynamos for electric lighting and the wireless, of which the instruments are carried in the observatory in the nose. The Astra plant has also worked out an efficient system of swiveling propellers, to be installed in their next leviathan. This plan has given great satisfaction on a small scale in England, but will eventually become of vital necessity, as no force of men could handle a mammoth dirigible so efficiently and economically on the ground in landing and starting as 1,000 horse-power applied to a swiveled propeller. Theoretically it would take a handling crew of 2,000 men to equal it

Newest Way of Detecting Art Forgeries

(Concluded from page 237.)

first shows a microphotograph magnified some two and one half to three diameters of one of the heads in the well-known Watteau in the Edinburgh National Gallery The second is the same head from a very careful copy by an accomplished artist, which, except for the fact that it is newer and shows the absence of cracks, it is very difficult to distinguish by the eye from the original. This is clearly seen on comparing the photographs of the original and the copy But the moment that the microphotographs are compared the weakness and inferiority of the brushwork in the copy is at once revealed, and also the want of delicate modeling in the drawing of the face and the ear. The third photograph is from the well-known Pater in the Edinburgh collection, and is of great interest as showing distinct resemblances to Watteau's methods, while, at the same time, the work is facile and shallow and wanting in the rich complexity and subtlety of the work of the master.

The sixth photograph is from the head of a man in the Teniers (No. 817) in the National Gallery, London, and is an interesting revelation of the brushwork of this great artist. I may say that his brushwork is extraordinarily minute, it being difficult to understand how he had sufficiently fine brushes to put in some of these tiny strokes, which it must be remembered are shown here highly magnified and are therefore almost too fine for the eye to see in the original picture.

The next two photographs are examples of the brushwork of Velasquez, and illustrate the importance of seizing the work of the artist in a carelessly rapid painting mood One is taken from the tassel on the "Silver Portrait" of Philip in the National Gallery, London, and the other is taken from the tassel on the leg of "The Spanish Admiral" Certain authorities have suggested that "The Spanish Admiral" is not by the hand of Velasquez, but, while a larger number of photographs would be required for absolute proof, a comparison of the brushwork in these two examples goes a long way to prove that "The Spanish Admiral" is by the hand of the great master.

Examples of the application of this process might be multiplied indefinitely, but probably the accompanying photographs will be sufficient to illustrate the process. It must not be supposed, however, that it is sufficient to take one or two photographs of a picture in order to make a proper investigation. The picture ought to be carefully studied under the microscope with a view to examining for repainting, and identifying the pigments and mediums. Certain portions should then be selected as characteristic examples of brushwork, and these again compared very carefully with other pictures supposed to be by the same master, and the [illegible] of the investigation both by

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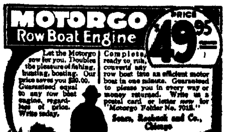

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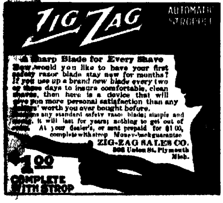

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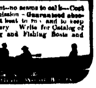

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These methods do not in any way supersede the work of the art expert. His opinion on the authenticity of the picture remains as valuable and important as ever But they come in to assist him in his labors, to limit the problem that he has before him and to check by exact methods the conclusion at which he may have arrived; and in cases where art experts differ as to the origin of a picture, such methods go a long way to bringing the matter to a definite conclusion. As an example, I have been lately trying to decide who is the original painter of "The Old Grey Hunter" in the National Gallery, London, ascribed to Paul Potter, and the results obtained are at present before Dr Bredius, who first suggested that this picture was by Verbeecq. I am also making a further inquiry into who is the painter of the portrait of Elizabeth Bas in the collection at Amsterdam, Dr Bredius having suggested that it is probably by Bol, and not by Rembrandt

The Tunnel Under the English Channel

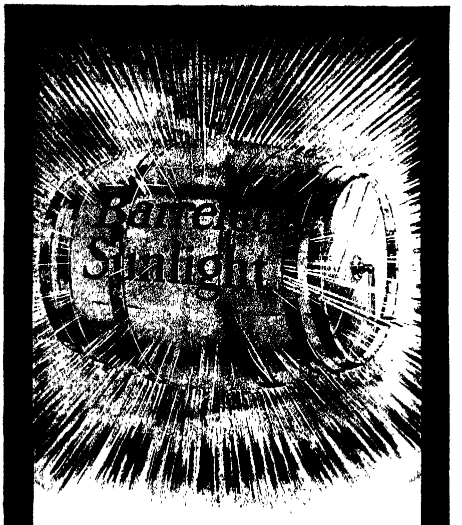
THE question of the tunnel under the English Channel is quite the order of the day in the two countries interested, and especially among persons who are occupied with engineering and economic questions Some interesting points about the proposed great work were set forth by M Monnier, professor at the Central School and chief engineer of the North Railway, in a recent conference on the subject. From an economic standpoint the construction of the tunnel will mean an enormous increase in passenger and all kinds of traffic, and will be a source of prosperity to England, France and other nations Capital will be easy to raise in both countries, and the cost is not expected to exceed $80,000,000. Technical difficulties appear to be less than for such mountain work as the Simplon tunnel and others What is intended for the channel enterprise is to work in the impermeable green chalk layer, and run two circular and parallel tunnels, with a railroad track in each tunnel Military preoccupations have now lost nearly all their importance in England in view of the good relations between the two countries, and it is considered that the enterprise cannot but add to ideas of peace and concord. The main obstacle to the realization of the project comes from the traditionalism which prevails in England, as it is held that the success and special qualities of the race largely come from the insular position of that country However, it is claimed on the other hand that such an idea does not fit into modern progress and that in the course of time it will lose its force, so that we may expect to see the project carried out at a not very distant date

Earthquakes and Changes of Latitude

AS long ago as 1903 Prof. Milne called attention to an apparent connection between displacements of the terrestrial poles and earthquakes. He found that in years when pole-displacements have been relatively large, world-shaking earthquakes have been numerous, and *vice versa.* Milne did not believe that the molar displacement represented by these earthquakes was sufficient to cause the polar change, but thought that both might result from a common cause. This subject has recently been investigated mathematically by Prof R. Spitaler, whose general conclusion is that the rapid axial displacement is the primary phenomenon and the earthquake secondary.

Large Lobsters

THE New York Aquarium has recently acquired a lobster weighing 21 pounds. Although this is a very unusual weight, specimens exceeding 30 pounds have been taken. According to the *American Museum Journal*, the largest known mounted specimens in the world are two in the American Museum of Natural History; one weighed when caught 34 pounds; the other, 31. These giants appear to be perfectly normal in every respect except size.



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(12958) R. F. F. asks: 1. In the September 27th 1913, issue of the Scientific American appeared an interesting article on "An Electrolytic Rectifier for the Garage." I would like to ask a little information on this subject, and will appreciate your assistance. As I understand, a rectifier of this type is made possible by the fact that aluminium has the peculiar property of receiving an electric current, but preventing its passage from the plate's surface, when immersed in certain liquids. This being the case, then as I see it, when the H. T. winding is at any one instant, say—polarity, as shown, the L. T. will of course be as shown. This means that the current inside the L. T. winding is flowing in the direction as shown by the arrow. As this current cannot leave the aluminium plate on the right, it must pass down the center wire and into the side of the battery, and from the—side up through the left plate and so to the—side of the L. T. winding. On the reverse side of the cycle, the conditions would be the same, except that the current then would pass through the right plate. Is this reasoning correct? And, if not, will you kindly advise me where I am wrong, and give me the right idea? A. The electrolytic rectifier depends upon the fact that aluminium is very easily oxidized, and thus, when the current passes from the iron to the aluminium, that is, when the iron is plus to the aluminium, the negative oxygen readily goes to the aluminium to oxidize it. But when the aluminium is plus to the iron, the current is largely suppressed. The result is that a succession of impulses all in one direction flows out from the electrolytic cell, constituting a unidirectional current, that is, direct but not wholly continuous. You will find the theory well stated in our Supplement 1644, price, 10 cents. 2. I would also like to ask you what you think of the following scheme. The transformer is an auto transformer so connected that I can get about 15 volts or whatever is needed to force the 2 to 3 amperes D. C. through the battery. I would use a single-cell aluminium and iron plate of about the same dimensions as given in the Scientific American article. The action would be very similar to the mercury arc rectifier, the whole action being based on the fact that the current cannot leave the aluminium plate, but *will* pass to it. Of course, some little experimenting might be necessary to secure the right voltage connections and sizes of iron and aluminium plates before the proper charging rate was secured, but I do not see why this would not work. If you see where I have reasoned wrong, will you kindly advise me? A. It is not a practical arrangement to use a single cell as you propose, because only one half of each cycle is utilized, and in addition there is a slight leakage on the other half cycle, which opposes the direct current. With two cells, an efficiency of 60 to 65 per cent can be obtained. The article in our issue of September 27th, 1913, does not discuss the theory at all, but simply gives practical data, which should be closely followed. 3. Further, you have the transformer wound with a ratio of turns 800 to 240, which with 110 volts H. T. would give 33 volts L. T. As I understand, since but half the L. T. winding is used at a time, the secondary voltage really is about 15. Is this correct? What I am driving at is this. I have one or two small transformers which I have made, and was figuring on using one of them, with a secondary voltage of about 30, and using the middle tap. A. The secondary voltage will be as you have calculated, about 16.5, since one half the secondary winding is in use at once. Should you wish different voltage, you can use a different ratio of winding, and employ the method shown in Supplement No. 1644.

(12959) S. G. asks: There is an alloy of potassium and sodium which is liquid at the ordinary temperature like mercury (NaK$_2$). I should like you to inform me whether this alloy has any practical uses (excepting its use in high heat thermometers, where mercury boils at 360 deg. Cent.), and especially whether it can be kept exposed to the air for any length of time? A. We are not able to give any information regarding this particular alloy and its uses. Perhaps some of our readers can supply the information desired. It certainly cannot be exposed to the air for any time. It would oxidize immediately.

(12960) S. P. asks: 1. Will you please answer this question for me? If a tree falls out in the woods, and there is no ear in hearing distance, is there any noise? Please explain this for me. A. There are two definitions of the word "noise." One is that which we hear, and the other is the cause of hearing, the sound of the falling tree, in the case which you propose, a tree falling in a forest. The same effect is produced in the air, by the tree falling, whether there is anyone to hear the noise or not, but if there is no ear to hear, there will be no sensation of hearing, and in this sense of the word there will be no noise. If you use the word as meaning a sensation, then there is no noise where there is no ear. If you mean the physical motion which causes such a sensation, then there is a noise, whether there is an ear to hear it or not. 2. What is noise? A. A noise is a disagreeable sound, because the different components are not harmonious.

NEW BOOKS, ETC.

Tierwanderungen in der Urwelt. Von Wilhelm Boelsche. Stuttgart: Franckh'sche Verlagshandlung, 1913.

In this excellent little book Wilhelm Boelsche, one of the most popular writers on scientific subjects in Germany, discourses interestingly on those migrations in the animal kingdom which have played their part in the evolution of species. The book may be recommended for its simplicity to those German-reading Americans who take an interest in biology.

Telephon- und Signal-Anlagen. Ein Praktischer Leitfaden für die Errichtung Electrischer Fernmelde- (Schwachstrom-) Anlagen. Herausgegeben von Carl Beckmann. Berlin: Julius Springer, 1914. Mit 426 Abbildungen und Schaltungen und einer Zusammenstellung der gesetzlichen Bestimmungen für Fernmeldeanlagen.

A text book of the theory, construction and operation of telephones, with full descriptions of accessories and lay-outs. It is profusely illustrated and is a valuable book, either for study or for reference.

Mechanics for Builders. Part I. By Edward L. Bates and Frederick Charlesworth. New York: Longmans, Green & Co., 1913. 12mo.; 201 pp.; with diagrams. Price, $1 net.

Part I of the work in hand is designed to meet the requirements of students attending classes but one evening each week; used in this way, it constitutes a first-year course, which Part II continues as a second-year course. But the work may all be completed in a single year if the student can devote more time to the subject. The appeal of the work lies in its adaptation to its viewpoint—it keeps the builder and building requirements constantly in mind and aims to make the examples and exercises typical and practical.

Modern Seismology. By G. W. Walker, A.R.C.Sc., M.A., F.R.S. New York: Longmans, Green & Co., 1913. 8vo.; 94 pp.; with plates and diagrams. Price, $1.40 net.

This authoritative monograph on present-day seismology is limited to its consideration as a branch of physics. Incidentally, it is an appreciation of Milne and his work; for this we are grateful, since Milne's position as the father of modern seismology has received scant recognition. The first four chapters deal with seismometry—dynamical theory, sensitiveness, damping and registration, the various types of seismograph, their standardization and installation. The latter part of the work comes under seismogeophysics, and treats of the theory of a solid isotropic earth, the interpretation of seismograms, and the determination of epicenter and focus. An interesting chapter is that on "Seismic Effects other than Those Due to Earthquakes." The work concludes with a statistical consideration of the subject.

The Economics of Telegraphs and Telephones. By John Lee, M.A., Traffic Manager Post Office Telegraphs. London and New York: Sir Isaac Pitman & Sons, Ltd. 8vo., 86 pp. Price, 2s. 6d., net.

This very interesting review of telephone and telegraph activity in its relation to social and commercial conditions is written from an English standpoint, but American practice and development occupies much space in the comparisons. Our tariff systems are commended, and we are given full praise for the degree to which we have availed ourselves of these modes of communication. The industrial and social influences and trends of telegraph and telephone operations are authoritatively sketched, and the study furnishes lessons for the present as well as prophecies for the future. The author's conclusions indicate the advisability of government ownership. He states that this is the natural conclusion to which research has led him, and not the result of any original bias.

Heaton's Annual. The Commercial Handbook of Canada and Board of Trade Register. 1914. Toronto: Heaton's Agency. 12mo.; 590 pp.

The present issue of the Annual completes the first decade of its publication. The traveler, the business man, anyone at all interested in the commonwealth across the border, will find here a wealth of useful information relating to the industries and activities of the Dominion. Its governmental departments, its titled people, its postal and cable regulations, and its customs tariffs and rules are embodied in brief but adequate statements. Its financial information is full and authoritative. There is a list of Canadian attorneys, others of railways and steamship lines and a table gives the cost of travel. The shipper's guide is a feature of wide appeal, and its "local opportunities" presents invaluable information to those interested. There is also a list of Canadian publications, and a section of tables dealing with currency, discounts, income on stocks, wages and freight.

Grundlagen der Physik des Fluges. Von Dr. Raimund Nimführ. Mit 10 Figuren im Text. Wien: Druckerei- und Verlags-Aktiengesellschaft vorm. R. v. Waldheim, Jos. Eberle und Co. Leipzig: Otto Klemm, 1913.

Practice Letters for Beginners in Shorthand. By D. J. George. New York: Isaac Pitman & Sons, 1914. Price, 35 cents.

First Lessons in Isaac Pitman Shorthand. New York: Isaac Pitman & Sons, 1914. Price 10 cents.

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Think of the joy of the Dutch burgomaster von Guericke, more than two centuries ago, when he proved to scientists of his time that electricity had the power to give forth light Think of these isolated experimenters turning cranks to light-flashes by friction, and of their endless groping to capture that light

Think of Franklin (one hundred and sixty years ago this past summer) flushed with excitement on discovering that the electricity of the sky could be conducted by a kite string

Think of the tremendous obstacles overcome in the production of Edison's first carbon incandescent lamp Electrical science was now to settle itself to the systematic study of this vast problem which in earlier days had been left to slow, blind, accidental advance And manufacture had begun to feel the impetus of help communicated by organized research, experiment and selection

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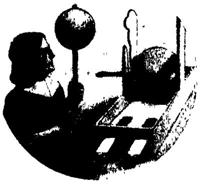

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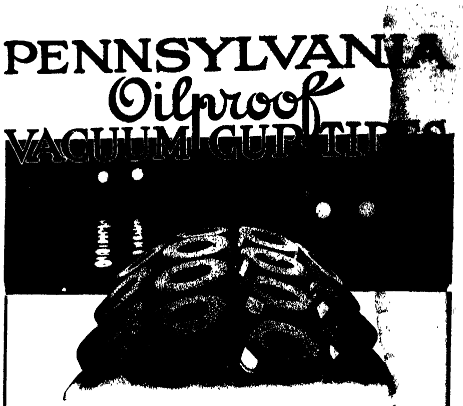

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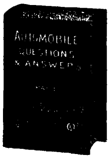

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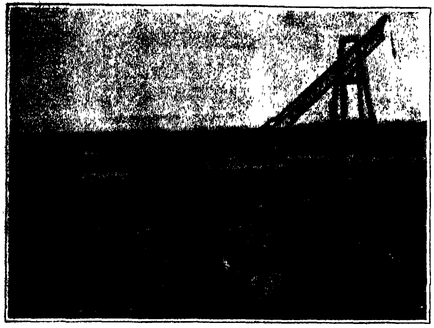

Fig. 1.—The conveyor bridge erected and in service.

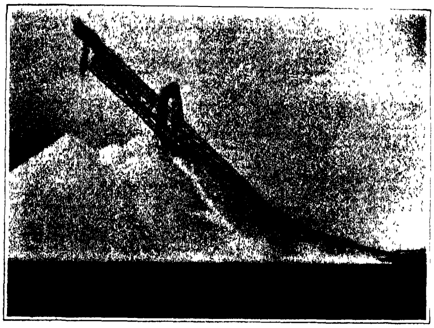

Fig. 2.—The dump growing rapidly under the conveyor.

Dumping Conveyor at the Brakpan Gold Mines

REMARKABLE as the highest, and perhaps the boldest construction of its kind in South Africa, is the sand conveyor at the Brakpan Mines of Johannesburg.

The refuse sand is drawn off from the cyanide tanks and shoveled into ropeway cars. These run down on an incline to the loading points, where they are stopped, and then proceed downward from the sand-treatment plant. At the extremity of this they pass out upon an inclined bridge, where they are clipped by means of a coupling apparatus to a traction rope in continuous motion, which hauls them up the bridge. On reaching the upper return sheave of the inclined bridge the cars discharge their contents automatically and return to the other side. The capacity of the plant amounts to about 180 tons of sand per hour. The single support of the inclined bridge is 166 feet high, the length of the bridge as first laid reached 200 feet in height, the bridge weighing 60 tons, and the lowest point of discharge for the cars being located at a height of 200 feet above the ground level.

Toward the close of the year 1909 the managers of the mines had under consideration a project to obviate the difficulties entailed by the employment of native laborers, and to handle the enormous quantities of material for which it is the usual custom on the Rand to employ belt conveyors. Although belt conveyors are well suited for handling material in bulk, and the total absence of frosts in the Rand district does away with the danger of handling moist sand, which is always present in our own climate, they, nevertheless, form a somewhat doubtful conveying agent for the material in question, because the finely ground quarts sand penetrates into the numerous axles and bushes, thus entailing great expense for repairs. Although the gold mines frequently employ belt conveyors for their other works, the above reasons decided them not to adopt this method for the removal of sand. They considered that closed boxes were, without doubt, the most satisfactory means of handling material which is detrimental to the mechanical conveying agent, because it remains undisturbed without being scattered or forming dust. An absolutely automatic traffic is equally possible on a ropeway as on a belt conveyor, and the dump can be readily extended, because it is only necessary to add further sections to the inclined bridge. At the beginning of the year 1910 the idea took definite shape, and it was decided that six cyanide tanks should first be served by the plant, and an additional four tanks connected at a later date. The suspension rails under the tanks were arranged horizontally for convenience in loading the cars, while the approach and departure were arranged at an incline. At the end of May, 1910, the contract was placed.

From a constructive point of view the nature of the material offered difficulties, as it has two natural angles of repose, one of 32 per cent for dry material, and the other of 42 per cent for moist sand The piling of the dumps by means of belt conveyors suffers greatly from these conditions because large quantities of steel structural work and open bridges are necessary to overcome these drawbacks. In the present instance it was, therefore, decided to erect only one lofty support, and to attach the inclined bridge to it, so that the dump could be gradually piled round the support, and under the inclined bridge, and in this way furnish ample support for the structural parts. This provided a basis for later extensions of the inclined bridge without providing supports, which is a characteristic of this type of bridge The angle of repose of the bridge was selected at 32 per cent, that is, for dry sand, because the carloads spread over the surface would rapidly dry

Definite data were available for the plant by July, 1910, whereby the daily capacity was assumed to be 1,000 tons, and the total length of the line 630 feet When working out the drawings, however, the plant was again extended, so that eight cyanide tanks instead of six were to be served The dispatch of the first mechanical parts was commenced at the beginning of August, and it was then that the first difficulties were met with. It was the intention of the mine management to have the steel work erected in South Africa, according to the drawings of the designers of this type of conveyor. When, however, the drawings arrived, and the contractor was able to appreciate the magnitude of the contract, he withdrew his tender, and negotiations lasted a month before a suitable firm could be found to undertake the erection of the steel work The bridge was put together on the ground, as the native laborers could not do the erection work up in the air The lowest cross-bars of the support were then loosened, and the slanting bridge drawn up with the aid of two 10-ton winches and pulley blocks The lower girders were then again set in place as shown in Fig 3, and the upper girders disengaged, in order to get the slanting bridge into its proper position This work was completed within a few days, and the bridge completely erected, as shown in Fig 1 The mechanical parts were speedily put on, and the conveyor was put into service at once

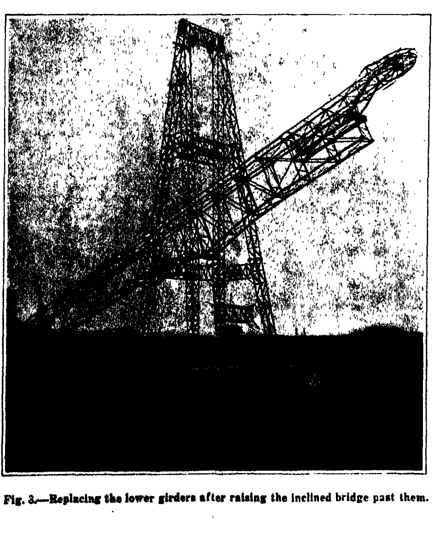

Fig. 3.—Replacing the lower girders after raising the inclined bridge past them.

As the dump gradually grew, the sand began to press against the supports, and it was, therefore, necessary (see Fig 2) now and again, to move the detent for tipping the cars on the slanting bridge, so that dumping could be effected evenly round the supports. The first extension of the bridge was ordered in January, 1913, as the dump had already reached a height of 200 feet at this point

The wire ropeway cars are equipped with an automatic coupling apparatus, which is actuated by the dead weight of the car It gives an absolutely safe and reliable clip to the rope on the heavy gradient of 32 degrees, besides offering the great advantage that it couples traction ropes of varying diameters with equal safety, so that no adjustment of the apparatus is necessary, even when in course of time the traction rope stretches somewhat, and its diameter becomes reduced The ropeway runs with an average power consumption of 60 to 90 horse-power

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Kodak Film Decision

THE decision recently handed down by the United States Court of Appeals, and printed on another page of this issue, upholding the Goodwin patent for the well known and widely used photographic film, contains one of the severest judicial arraignments of our patent system ever penned. It ought to be read by every congressman, by every inventor, by every manufacturer who makes patented goods—read because the daily press, scenting here the story of David and Goliath in a new form, has conveyed the impression that a struggling but obstinate clergyman was hounded by a great corporation with the sensational result that he came off the victor. We fear that the public will lose sight of the fact that a corporation has its rights as well as a poor inventor, and that the Eastman Company was entirely justified in exhausting every legal effort to evade a patent which it considered invalid.

Not the fact that a poor clergyman ultimately succeeded in beating a wealthy corporation (but with very powerful support, be it mentioned in passing) is to be taken to heart, but the shocking conditions which have rendered it possible to continue a dispute over the validity of a patent for a quarter of a century.

Eleven years and four months elapsed before the patent was finally granted. It had to run the full gamut of motions, counter-motions and appeals that make a patent interference a sore trial. And then, ten years and eight months elapsed after an infringement suit was brought before a United States District Court sustained five claims.

Apart from these delays, the history of the application in the Patent Office reflects no credit upon the officials. Five different examiners rejected the application during its eleven years' pendency in the Patent Office. No wonder the Court remarked: "Surely an extraordinary and deplorable condition of affairs!" No wonder, too, that the Court observes: "Most of the complications in the case would have been avoided had the Goodwin patent gone to issue in due course, as it should have done. The long delays and the contradictory rulings of the Patent Office would have discouraged an inventor who had not supreme faith in the justice of his cause."

The manner of conducting infringement suits has happily been vastly improved since the Supreme Court of the United States has laid down new rules. But the Patent Office cannot thus reform itself. Only congressional legislation can simplify the procedure in the Patent Office so that an inventor's vitality and finances may not be sapped by the interference incubus and so that a patent, which on its very face relates to novel subject matter, may be speedily granted. The SCIENTIFIC AMERICAN and other members of the technical press have for years insisted upon a more adequate protection of intellectual property. Latterly the magazines and the newspapers have taken up the fight. Perhaps this increasing hue and cry may at last be heard by our legislators.

The Washington-Paris Longitude Campaign

TO obtain the difference of longitude between two places on the earth's surface it is necessary to obtain their local times by star observations, and to effect an exchange of signals by means of which these times may be compared. The difference of the local times, at the epoch of comparison, is the required longitude difference. Among the many applications of wireless telegraphy to scientific purposes, the providing of a means for furnishing such signals in longitude operations is not the least. Particularly is this of value *to geographers and explorers of unknown lands*, and in other regions where the ordinary telegraph wire has not yet penetrated. During the past decade longitude determinations with the aid of radio signals have been effected in various parts of Europe, in Japan, and by the American Navy.

Transatlantic longitudes have hitherto depended on signals communicated over the cable; but experiments last spring having demonstrated the feasibility and advantages of wireless telegraphy, preparations were begun and plans laid for a determination of the longitude difference between Washington and Paris. This longitude campaign, at length opened in October, is now drawing to a close. Engaged in the operations are both Americans and Frenchmen, working separately and independently, each in co-operation with fellow countrymen on the other side of the ocean. There are thus four parties, two at Washington and two at Paris, each composed of astronomers and wireless experts, the former to make stellar observations, the latter to detect and note the radio signals. Synchronized by the standard clocks of the respective observatories, these signals are sent out, on the American side, from the powerful naval wireless station at Arlington, Virginia; and on the French, from the Eiffel Tower, Paris. Detected both by ear and by a sensitive photographic apparatus invented by the French, they are made use of not only for longitude, but also, through a knowledge of the distance separating Paris from Washington, for calculating the speed of propagation of the Hertzian waves. It may be added that similar experiments in other longitude campaigns have demonstrated this speed to be substantially that of light.

The longitude instruments employed are of the highest type known to astronomers, designed especially to eliminate, as far as possible, instrumental and personal systematic error. To guard against the possibility, nevertheless, of small residual personal equation influencing the results, the parties at Washington and at Paris exchanged places about the beginning of the year, carrying their instruments with them. At the time of this interruption, after a period of some three months, but six or seven favorable nights' work had been obtained. As a favorable night calls for clear observing weather both at Paris and at Washington, as well as conditions of the ether such as will permit satisfactory transmission of wireless waves across the ocean, it will be readily understood why it was planned to extend the campaign over a period as long as five or six months.

One advantage of radio over other methods of signal transmission is that anyone, with small receiving apparatus fitted up at slight expense, can detect the signals. The opportunity has accordingly been seized by a number of observatories on this side of the Atlantic to receive and record these signals, and in conjunction with astronomic observations, to obtain simultaneously their longitude differences from Washington. Longitude operations of a higher order of precision will doubtless, in time, be extended across the continent, and ultimately around the world. Frequent redeterminations are also proposed for the purpose of discovering possible creepings of the earth's crust.

The longitudes determined in the last century by cable differed from those previously obtained through more primitive methods by a second and a half of time. It will be interesting to learn how they agree with the wireless results, and how concordant will be the French with the American values. Longitude by wireless, after all, is still in the experimental stage. Publication of the methods employed and results obtained will be awaited by men of science with deep interest.

An Unsinkable Ship

THE term "unsinkable" as applied to ocean-going ships is strictly relative; and as so used, it means a ship which is unsinkable by any of the conceivable accidents of the sea which might overtake her. Such a ship would act as her own lifeboat, and were it not for the risk of fire, might dispense with the long lines of boats which crowd the top deck of the modern liner. The accident which sank the "Titanic" was of such a severe and unprecedented character that its recurrence, in the exact manner and with the same extent of injury, though conceivably possible, is certainly not likely. Nevertheless, since such an accident did happen, common prudence demands that the modern liner, to which is intrusted the lives of some five thousand people, shall be so constructed internally as to be proof against even such a terrific injury as that which sank the "Titanic."

At the time of that disaster, we were unsparing in our criticism of the construction of the ship, and therefore it gives us great pleasure to note that in their latest vessel, the "Britannic," recently launched, the White Star Company has so greatly improved the safety elements in the way of bulkheads and inner skins and watertight decks, that the ship could undoubtedly pass through such a severe ordeal as happened to the "Titanic" and yet remain afloat. Furthermore it is to the credit of the company that they have considerably exceeded the provisions for safety embodied in the report of the International Conference on Safety at Sea which sat in London last winter.

The "Britannic," which is 900 feet in length and of over 53,000 tons displacement at low draught, is provided with a double bottom over five feet deep, which is increased to over six feet throughout the machinery space. This bottom is divided by the transverse frames and by longitudinals into a vast number of watertight cellular compartments. Furthermore, we are pleased to note that the suggestion which the SCIENTIFIC AMERICAN made at the time has been followed in carrying the inner floor of the double bottom up the sides of the vessel to a height of several feet above the load-water line, thus providing throughout the boiler and engine room spaces a complete inner skin. The space between the outer and inner skin is thoroughly subdivided by the ship's frames and by a series of longitudinal girders.

Equally important as a safeguard is the fact that the main transverse bulkheads have been carried up, all of them at least one deck higher, and many of them two or three decks higher than they were in the "Titanic." There are sixteen of these bulkheads, five of which extend to a height of over forty feet above the deepest load line, while all the others are [illegible] to a height of over 21 feet above the water line. [illegible]ticular attention has been given to the design of these bulkheads, which have been specially stiffened [illegible] stand the maximum water pressure that can co[illegible] them, due to the deepest possible submersion of th[illegible] in case of injury. Forward and aft of the boil[illegible] machinery spaces, watertight steel decks, or "fla[illegible] they are called, have been worked in at or belo[illegible] water line; and this means that in the event of [illegible] a rupture of the skin as happened in the "Titanic," [illegible] water would be confined below these decks.

Another special safety provision is found in the unusual power of the Marconi apparatus on the "Britannic," which will have a transmitting radius of about 2,000 miles. An emergency power station has been built on a deck far above the water line to supply current for various purposes in case of accident to the main power station.

Excellent also and very original is the means provided for launching the lifeboats of which the ship carries forty-eight, two of which are fitted with powerful motors. The lifeboats are in four separate groups handled by a new type of davit which is practically a pair of powerful shear legs. These are so long that they will swing inward to the center of the ship, and outward so far that the boats may be lowered safely at any possible angle of heel of the ship.

George Westinghouse

THOSE who were privileged to know the late George Westinghouse will always remember that the thought of the vast benefits his inventions were conferring upon mankind was to him at all times *a source of deep satisfaction*. To mention Westinghouse is to think of the airbrake, which may safely be described as the greatest of all contributions to the safety of railroad travel. It was characteristic of the man that, great as was the early success of the airbrake, Westinghouse was ever industriously applying himself to its improvement; only recently we recorded a development of this brake as important, perhaps, as any produced since its inception. Equal in importance to his work on the airbrake was his influence in introducing and developing the alternating current system for electric light and power. With the patience, energy, and indomitable courage which marked the man, he purchased the original patents, developed them, introduced the system and made it thoroughly practical in this country. Safety in railroading is indebted to him also for the pneumatic-electric system of automatic signaling. Broad-minded and keen in his outlook, he was quick to recognize and purchase foreign patents of value and introduce them into this country, as witness the Parsons steam turbine and its widespread commercial development under his hand. His latest and most notable work was the invention and development of a practical, mechanical reduction-gear, for transmitting large powers, which is to be used in two new battleships and a repair ship of the United States Navy. Mr. Westinghouse's death occurred March 12th, in this city, in his sixty-eighth year. He won many distinguished honors abroad, receiving the Legion of Honor from France, the Order of the Iron Crown from Italy, and a decoration from King Leopold. He was awarded also the John Fritz Medal, bestowed by the leading engineering societies of the United States. The Royal Technical High School of Berlin gave him the degree of doctor of engineering. As showing the wide range of his activities, it may be mentioned that there are now between thirty-five and forty Westinghouse companies in Europe and America, capitalized at $200,000,000, and employing about fifty thousand persons.

Electricity

Longest Submarine Telephone Cable.—The telephone cable which is to connect Aldeburgh, England, with Walcheren, Netherlands, is to be 79 nautical miles in length, making it the longest submarine telephone cable in the world. It will furnish telephone communication between London and Berlin. The cable is to be of the four-core Pupin loaded type.

Linking Germany With Her Colonies.—The German government is negotiating with Holland to obtain permission to erect a wireless station on the island of Sumatra (Dutch West Indies). Such a station would, on the one side, be able to communicate with German East Africa, and, on the other, with the Caroline Islands. If this plan succeeds, all the German colonies would be able to communicate with Berlin without being obliged to make use of any cable. This would alleviate one of Germany's greatest grievances—that in communication with its colonies it is now so dependent upon Great Britain, which controls most cables.

Recent Telephone Statistics.—According to a preliminary report given out by the Director of the United States Bureau of the Census, 20,248,326 miles of telephone line were in use in the United States during the year 1912. This represented an increase of 313.2 per cent during the decade. In 1912 the Bell system controlled 74.7 per cent of the wires and 58.3 per cent of the telephones. The estimated number of messages or talks for the year was 13,735,658,245. This figure does not include messages for the 1,402,840 telephones of small companies which had an income of less than $5,000 during the year. The messages reported by the Bell system include only completed calls, while those reported by other companies may include some "line busy" or "do not answer" calls.

Death of John Gott.—Mr. John Gott, a pioneer of submarine telegraphy, died at Brighton, England, on March 8th, at the age of 75. He entered the telegraph service in 1852. From 1855 to 1864 he assisted in cable laying in the Mediterranean and the following year he was one of the crew of the "Great Eastern" on her first attempt to lay a transatlantic cable. He became the superintendent of the French Atlantic Cable Company's station at St. Pierre, Miquelon, in 1869, and has been chief electrician of the Commercial Cable Company since its inception. However, his greatest achievement came in the last year of his life when he developed a system of cable telegraphy, employing a Morse sender and receiver, thus doing away with the syphon recorder and making it possible to relay the messages from and to land lines. Nine months ago a message was sent through from San Francisco to London without retransmission. A description of the system was published in the SCIENTIFIC AMERICAN of November 22nd, 1913.

New Electric Locomotive.—Among recent European electric locomotives we may mention the one built for the Rhätische railroad system. It is being used on the St. Moritz-Schuls line which has a branch from Samaden to Pontresina. The line is narrow gage and is supplied by single-phase current at 10,000 volts and 16 2/3 frequency, the locomotive being required to draw a train of 20 tons maximum. The locomotive carries two electric motors of 350 horse-power each. A single countershaft takes the power from both the motors by gearing, and this shaft serves to run all four driving wheels on a side. Between the third and fourth locomotive axle is mounted a false axle which receives power from the countershaft by means of a crank, and this axle serves to operate the four locomotive axles. The present locomotive runs very well in actual service, and during the first three months it is stated to have covered 8,500 miles. Current comes from an overhead trolley wire by two pantagraph trolleys, the locomotive being of the square or box-built type.

New Telephone for the Deaf.—One of the newest telephone devices for the use of the deaf is the German "phonophor," consisting of a telephone transmitter worn on the person or placed upon a table, and a small telephone held to the ear. The most novel form of the device is the one intended to give a great reinforcement to the sound by the use of powerful telephones, and here it is made up for ladies' use in the shape of a small leather handbag of familiar shape. Lifting up a flap uncovers a pair of microphone transmitters, and the bag is simply placed on a table, a store counter or the like, while a small hand telephone is held to the ear, or the latter device can be used as a head clamp by a little adjustment. The bottom of the bag is flat so as to stand upright, and it can not only contain the battery and the ear device, but also leaves room for other objects. Sounds are made still louder by a more powerful type intended for men's use, and it has the appearance of a kodak box with four microphones inside, whose openings are flush with the surface and covered with perforated plates. The box is placed on the table and a light headpiece holds a telephone to the ear.

Science

Standard Time in German East Africa.—Uniform time of the meridian 37 deg. 30 min. east was officially adopted in German East Africa on October 1st, 1913.

An International Congress of Ethnology and Ethnography will meet at Neuchatel, Switzerland, June 1st to 5th, 1914.

An Important Event in Asian Geography was the recent linking up of the survey of India with the Russian triangulation in the Pamirs, a task which has involved five years of labor. Some of the British stations were at altitudes ranging from 18,000 to 19,000 feet above sea-level.

Sir Isaac Newton's House, No. 35 St. Martin's Street, Leicester Square, London, is about to be pulled down, as it is in so ruinous a condition that any attempt to preserve it would be hopeless. This house is not only historic on account of the great philosopher's residence here from 1720 to 1725, but also as the home subsequently of Dr. Burney, the composer, and his daughter Fanny, who wrote her first novel, "Evelina," here.

The Katmai Dust Cloud, which caused a general haziness of the atmosphere over much of the northern hemisphere, reaching a marked maximum in August, 1912, appears to have now practically disappeared. As pointed out by Prof. Kimball, the duration of this cloud was somewhat less than that due to the eruptions of 1902–03, which lasted two years, and markedly less than that of the dust ejected by the great Krakatoa eruption of 1883.

Explorers Killed by Cannibals.—It is reported that a forester named Deininger, who was attached to the Woods and Forests Service of German East Africa, but had been sent to New Guinea to help organize the forest service there, has been murdered by cannibals in the island of New Mecklenburg, where he was collecting specimens of valuable woods. Another German scientist and fourteen native companions are said to have shared his fate.

A New Volcanic Island has appeared in the Bonin group, three miles east by south of Iwojima Island. It is five miles in circumference and attains a height of 1,000 feet. The appearance of this island is especially interesting for the reason that the other Bonin Islands, although of volcanic origin, are believed to date back to Eocene times. They contain no hot springs, and are not subject to earthquakes.

New Atmospheric Gases.—In a paper read before the British Association meeting at Birmingham, F. W. Aston reported investigations which indicate that neon, one of the rare gases of the atmosphere, is really a mixture of two gases, which are identical in all their properties except atomic weight. That of the heavier is 22.1, and of the lighter 19.9. Ordinary neon appears to contain about 12.5 per cent of the heavier gas. The spectra of the two gases appear to be identical.

Yet Another Antarctic Expedition is in prospect, according to plans briefly outlined in *Petermanns Mitteilungen.* This will consist of an attempt to trace the entire outline of the Antarctic coast, and will be undertaken by Commander Evans, who succeeded Scott in command of the last British expedition. His plan is to circumnavigate the continent, keeping as close to the shore as the ice will permit, and making numerous landings. The geographical importance of such an undertaking equals or exceeds that of Shackleton's proposed trans-Antarctic journey.

World-shaking Volcanic Earthquakes.—One of the most interesting facts in connection with the recent eruption of Sakurajima, in Japan, is that earthquake shocks were strongly registered in Europe at the time of the shocks which attended the eruption, and caused so much damage in the neighboring city of Kagoshima. According to C. Davison, who discusses the subject in *Nature*, this is the first time that a volcanic earthquake has been recorded across an entire continent since the horizontal pendulum was adapted for seismographic purposes. Volcanic earthquakes as a rule are decidedly local, indicating that the seat of the disturbance is at a very moderate depth in the earth.

Periodical Medical Examinations for Everybody, as a means of detecting and checking disease in its earliest stages, were earnestly advocated by Dr. Victor C. Vaughan in an address on the subject of preventive medicine before the seventh annual meeting of the Association of Presidents of Life Insurance Companies. Looking into the future, the speaker told of the time when "everybody goes to a physician twice a year and undergoes a thorough examination. The result of this examination is stated in a permanent record, and no two consecutive examinations are made by the same physician, in order that a condition overlooked by one may be detected by another. Cases of doubt, or in which there is difference of opinion, are referred to special boards." Dr Vaughan indorsed the proposal that the insurance companies offer their policy holders free medical re-examination at stated intervals; a plan that would probably benefit the companies financially through the increased longevity of the insured.

Inventions

Typewriter Eraser Operated by a Key.—In patent No. 1,083,466 Harry I. Seddon of Portland, Ore., provides an erasing means for a typewriter in which an erasing head is yieldingly pivoted on a bar and the latter is connected to a key lever so that the key lever may be moved to operate the eraser.

Uniformly Curved Trifocal Lens.—Henry Boldo of New York, assignor to the Meyrowitz Manufacturing Company, has patented a trifocal lens in which two minor lenses are seated respectively in the two faces of a major lens, both of the faces of the completed lens being of uniform curvature throughout.

Rimless and Removable Eye-glass Lenses.—Rimless eye-glasses, in which the lenses are detachably mounted in a wire holder, are shown in patent No. 1,084,262 to Robert James Fleming and Thomas Alfred Robinson of London, England. It is claimed that the lenses are securely held and may be easily fitted and removed by the wearer.

A Hollow Metallic Propeller.—Pierre Jacomy, Asnieres, France, in patent No. 1,082,750 presents a light hollow metallic propeller which is made of a single piece of metal in the form of a weldless tube with its edges or ends of a decreasing cross section and the ends formed into helical blades, openings at the center receiving a sleeve.

A Novel Nozzle for Cotton Pickers.—Emil Gathmann of Baltimore, Md., has provided a nozzle for pneumatically operating cotton pickers which flares outwardly funnel shape and has on its inner side a spiral-toothed rib with a plurality of connected convolutions designed to engage the cotton, dislodge from the boll and direct it inward into the machine.

An Improved Moving Picture Screen.—A patent No. 1,082,123 was issued to Samuel H. Jones, of Altus, Okla., for a process of producing a moving picture screen in which an oil-cloth base is subjected to a softening oil after which a coating of jap-a-lac and turpentine and after that has partially dried a metallic powder is rubbed in until a velvety sheen is produced. It is claimed that the pictures thrown on such screen will be more distinctly shown and brought out more in detail and that the screen can be used in daytime.

A Process of Canning Asparagus.—Patent No. 1,083,311 to George W. Weber of St. Paul, Minn., assignor to American Can Company, of New York, presents a process of canning asparagus and other food products in which the asparagus or the like is placed in a sheet-metal container and the container is subsequently reduced or compressed midway between its ends to grip and hold the food product and prevent it from movement within the container, thus preventing any breaking up that might result from its moving about in the can.

Automatic Lock Release for Express Safes.—In patent No. 1,083,101 John Holeck and David Schwartz of Milwaukee, Wis., provide an express safe for cars in which there is an inner stationary receptacle, a stationary outer casing and an interposed rotary shell which is driven from an axle of a railway car and lock mechanism for the doors of the shell and casings are provided. The lock mechanism is entirely within the safe and prior to closing the safe the operator sets the pointer to correspond to the number of miles to the next station or point determined upon where the automatic unlocking takes place.

A Crown Seal Closure that Will "Pop."—In patent No. 1,082,696 to Arthur W. Hicks, administrator of John Augustus, deceased, is shown a bottle closure having a metal cap secured over the mouth of the bottle and a lining in the cap which has an impervious adhesive face which adheres hermetically to the bottle mouth while the lining is unattached to the cap so that in removing the cap from the bottle the top is separate from the lining and the lining will be blown from the bottle mouth with an explosive sound by the pressure of gas in the bottle.

Rescuing From Submarine Boats in European Navies.—The subject of saving lives of men on submarine boats, the mechanism of which has been deranged, has been attracting considerable interest throughout the world recently. The importance of this subject was brought out by a recent disaster in the British Navy. Several European navies have installed apparatus on their submarine boats for renewing oxygen and absorbing the products of respiration from the men on the boat for a period of seventy-two hours, during which time it is usually possible to effect a rescue which otherwise would be prevented by the men suffocating. Another popular method is to locate in the boat a number of little machines designed to shut off the respiratory organs of the wearer from the water, and permit him to breathe fresh air supplied by a special device until he can rise to the surface of the water, after which the device may be thrown away, the balance of the apparatus serving as an ordinary life preserver until rescue can be effected. These little machines have also been used for rescue work at bathing beaches very successfully.

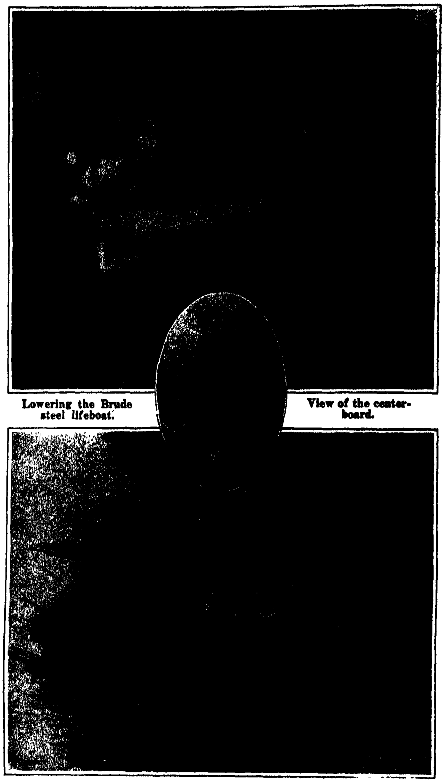
A Real Lifeboat

By Robert G. Skerrett

THEORETICALLY, at least, a lifeboat is deserving of that name when it measures up to the requirements imposed by the exigencies of the service for which it is designed. As a broad proposition, lifeboats upon seagoing craft are provided in order that the passengers and crew may leave a stricken vessel, or that they may be put overboard from a succoring craft for the purpose of rescuing others in distress. To do this, the lifeboat should be of such an order that it could be gotten into the water with haste and not impose too much skilful handling to accomplish this effectively. Next, when afloat, it should be capable of carrying and protecting the while those within it. The boat should be so constructed that it would live in a stormy sea, and while making harbor or awaiting the coming of aid, be able to keep alive those that it has taken from the abandoned ship. How far does the average lifeboat live up in fact to this theoretical standard?

Thirty-one men—all hardened and experienced seamen—tried to get away from the oil-tanker "Oklahoma" during a recent frigid storm. One boat capsized after hitting the water, and six out of the eleven in her were drowned. The five others were rescued through the courage of a boat's crew from another craft. The second boat got away with twenty aboard, but seventeen of these had disappeared when relief came. Two of the three remaining were dead, and the other died without regaining consciousness All perished of exposure.

On some sixty vessels flying the flags of Norway and the United States, there is installed a type of lifeboat which uniquely meets the ideal requirements. The boat is the invention of Capt. Ole Brude, an experienced mariner. The Brude boat is built of steel with a deep double bottom in which can be carried both drinking water and water ballast; it is equipped with a lowering centerboard to facilitate sailing; and is globular in shape by which it is possible *to protect the passengers from* the sea and the weather Because of its *form, method of construction, and heavy* wooden guard, the boat is exceptionally strong. It is *non-capsizable*; virtually non-sinkable; and, with persons inside, has been dropped without harm from a height of nearly forty feet. When the two circular hatches are closed, the boat, *pro tem*, is as snug as a submarine. A boat of this type is in fact a lifeboat and liferaft combined, and has an inside seating capacity for thirty persons, but can carry and support forty-five more outside. A boat of this type crossed the Atlantic in mid-winter a few years ago under sail, and weathered several severe gales on the journey. The four men aboard of her suffered no inconvenience despite the bitter weather It was the successful conclusion of this convincing practical test that gave the Brude boat its first recognition. This is the character of lifeboat that should be generally provided for all ocean-going steamers, as it is a lifeboat in the fullest sense of the term.



Lowering the Brude steel lifeboat.

View of the centerboard.

The insert picture showing the lifeboat on the open sea on the way from Norway to America.

The Brude boat undergoing test by the United States inspectors.

The Homing Instinct in Crabs is illustrated in some cases recently reported from England. Several crabs from Yorkshire, liberated at Skegness, in Lincolnshire, walked home again A most remarkable case was that of a pair of crabs, male and female, which were taken in the same trap off the Yorkshire coast They were carried to Lincolnshire, marked, and returned to the sea at different places along the coast. In the course of time the same pair, having found each other in the sea, were captured together a second time in a trap at their original home in Yorkshire.

Cinematographs of the Aurora, taken by Carl Störmer at Bossekop, Lapland, are reproduced in a recent number of the *Comptes rendus* Most of his attempts to obtain such pictures were unsuccessful, on account of the feeble luminosity of the phenomenon, but on three occasions, during particularly bright auroras, he secured excellent results. Each image was given an exposure of from one half to one second.

Enlarging and Reducing Phonograph Records

By R. Arapu

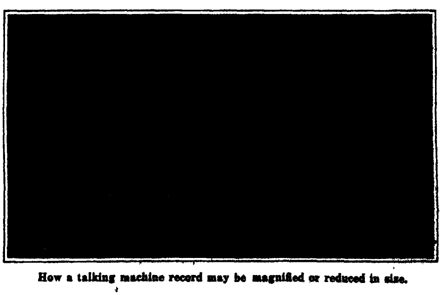
THE ingenious method of enlarging and reducing phonograph records, which is here described, was invented by M. Georges LeRoy, director of the chemical laboratories of the city of Rouen

Phonograph records, i e., the traces made on wax disks or cylinders by the needle of a recording phonograph, can be enlarged or reduced by the following physico-chemical process, without the aid of the pantograph, by which such reproductions have hitherto been made exclusively. In the first place it should be observed that the new process is superior to the pantographic method because it excludes the employment of levers and other mechanical organs, which inevitably affect the record by means of their own vibrations and reactions. On the other hand, the record may be improved by employing the new process. In current practice, the primary wax record is made by means of sounds of exaggerated loudness in order to produce a strong impression, and injurious secondary vibrations are thus evoked and recorded. By the new process a record made with tones of moderate intensity, free from disturbing secondary vibrations, can be enlarged until it produces tones as loud as may be desired. Conversely, a record made with loud tones can be reduced, and thereby softened, in addition to being compressed into smaller compass.

Principle of the Process.—The enlargement is effected by the dilatation of molds of the primary record, made of material which is greatly dilated by prolonged immersion in appropriate solutions; for example, gelatine immersed in aqueous solutions, or vulcanized rubber immersed in carbon disulphide. Conversely, the reduction is effected by the contraction produced in similar molds by appropriate treatment, as by the dessication of a mold composed of highly hydrated gelatine.

Technique of the Process.—From the primary wax record a copy is made in copper by galvanoplasty. For enlargement a mold of this copper record is made in a concentrated solution of gelatine, containing 30 to 50 per cent of dry gelatine. The gelatine mold is immersed in cold or tepid water, pure or containing substances that promote the expansion of the gelatine. When the mold has attained the desired size it is made insoluble by immersion in a solution of formol, and is then molded in wax or plaster. From the wax or plaster mold is made a galvanoplastic copper matrix, or master record, with which the working records are stamped. The diameter of the soft gelatine disk can be tripled by immersion, and the enlargement can be increased indefinitely by repeating the process on gelatine copies of the enlarged plaster or copper matrices.

For reduction the copper plate made from the primary wax record is used to produce a copy in weak gelatine, containing 10 to 25 per cent of dry gelatine, which is dehydrated by immersion in dilute alcohol, a solution of sodium sulphate or of Rochelle salt, by exposure to a current of dry air, or by the action of a vacuum desiccator. The gelatine record, thus contracted and reduced, is copied successively in wax or plaster and in copper, in the manner described above. The diameter of the gelatine disk can be contracted to 60 per cent of its original value, and the reduction can be continued indefinitely by contracting gelatine disks made from the reduced copper plates. In the accompanying photograph No. 2 represents an original record of 120 millimeters diameters, No. 1 a reduction to 80 millimeters, No. 3 an enlargement to 190 millimeters, and No. 4 a second enlargement to 340 millimeters.



How a talking machine record may be magnified or reduced in size.

1. Shows a reduction to 80 millimeters diameter. 2. The original record of 120 millimeters 3. An enlargement to 190 millimeters. 4. A second enlargement to 340 millimeters

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Protective Spectacles for Glassworkers.—At a recent meeting of the Royal Society Sir William Crookes described some experiments on which he has been engaged to produce a kind of glass for use in spectacles which will cut off the extreme heat rays that are so injurious to the eyes of glassworkers in causing cataract, without obscuring too much light or materially affecting the color of objects seen through the glass. He sought also to cut off the ultra-violet rays. Although the ideal glass, which would transmit all the colors of the spectrum, but cut off the invisible rays at each end, has not yet been found, he has produced spectacles which transmit less than 10 per cent of the heat rays, and none of the ultra-violet, and are sufficiently free from color for practical use. He doubts whether absolute freedom from color is desirable. After experimenting with a great number of elements he found that combinations of two or more of the following were likely to come nearest to the desired result; Cerium, chromium, cobalt, copper, iron, lead, manganese, neodymium, nickel, praseodymium, and uranium.

The Rise in Prices and the Increased Cost of Living

Changes in Leading Manufacturing Countries of the World During the Period 1900-1912

By John B. C. Kershaw, Fellow of the Royal Statistical Society, London

THE industrial unrest, which is such a marked feature in all the civilized countries of the world at the present time, has been ascribed to many causes. In an article published in April, 1912, in the *Engineering Magazine* (New York), the present writer analyzed these causes in some detail, and stated his opinion that the increased cost of food, and the rising standard of comfort and luxury demanded by the workers, were the two primary and chief causes of this unrest, and of the general demand for higher wages.

In the present article it is intended to give facts and figures in support of this opinion, drawn chiefly from an important publication relating to the "Cost of Living of the Working-Classes," issued recently by the Statistical Department of the British Board of Trade (Cd. 6,955, 1913). This report, although dealing primarily with the conditions obtaining in Great Britain, covers the rise that has occurred in food prices in the leading manufacturing countries of the world. Other publications drawn upon are: No. 137 of the Annals of the American Academy of Political and Social Science, published in July, 1913 (this deals entirely with the minimum wage in its relation to the cost of living); an address by Prof. H. N. Dickson, and a paper by Prof. Fisher of Yale University, read and discussed at the British Association (Birmingham) meeting in September last. Publications of this kind, however eminent their authors, are not read by the general public. The purpose of this article is to render the valuable information contained in these reports, addresses and papers available for a much wider circle of readers, and to present certain of the data in more easily digested and attractive form.

The Increased Cost of Food.

On page 62 of the introductory summary of the Board of Trade Report on the cost of living, already referred to, there is a most valuable table showing by means of "index numbers" the changes in the level of food prices which have occurred in the United Kingdom and its colonies and in certain foreign countries in the years 1900–1912. In this comparison the year 1900 is used as a base year, and the retail or wholesale prices of food in each country are taken as represented by 100 in that year. Since comparative figures of this kind are much more illuminating when presented in graphic form, the author has constructed diagrams I. to IV. from the official data. The figures themselves, which represent a vast amount of time and trouble on the part of those responsible for their collection, are given for purposes of reference only in Table I.

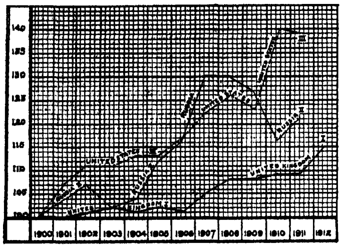


Fig. 1.—Diagram to show changes in the level of food prices in the United Kingdom, Russia, and the United States in the period 1900-1912.

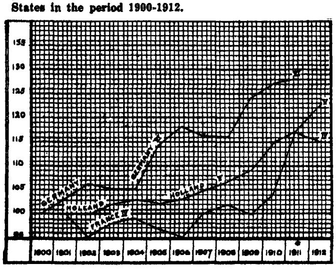


Fig. 2.—Diagram to show changes in the level of food prices in France, Holland, and Germany in the period 1900-1912.

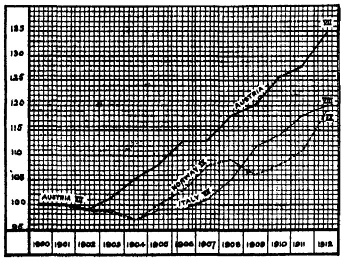


Fig. 3.—Diagram to show changes in the level of food prices in Austria, Italy, and Norway in the period 1900-1912.

Diagram I. gives the curve for the changes in food prices in the United Kingdom, Russia and the United States in the years 1900–1912. The rise is seen to have been practically continuous in all three countries, but whereas in 1911 the United Kingdom only showed an increase of 9 per cent, in Russia the increase had been 21 per cent, and in the United States the curve of prices had attained a level of 139, equivalent to an increase of 39 per cent on the prices of 1900. In Diagram II the price curves for France, Holland and Germany are presented in a similar manner and on a similar scale. Here we see that between 1901 and 1906, France benefited by a decline in food prices, the index numbers for which dipped down to 95 (or 5 per cent below the standard), in the years 1902 and 1906. Since 1907, however, the rise in food prices in France has been very marked, and in 1912 they reached their maximum of 117, equivalent to a rise of 17 per cent on the 1900 standard. In Holland the rise has been steady and continuous, and the curve has approximated in form to that of the United Kingdom, ending in 1912 at a level of 123, as compared with 115 for the United Kingdom. Holland and the United Kingdom, it may be pointed out, are the two free trade countries of Europe, and therefore, if free trade means (as its supporters declare) cheap food, one would expect to find the rise in prices much less striking than in highly protected countries. Whether this expectation is justified by the curves shown in Diagrams I. to IV., the writer of this article will not attempt to decide, since it would lead him away from the real purpose of this section, which is to present facts. The German curve shows a slight dip in the years 1907–1908, when the price of food in Germany declined, but since the latter year the rise has been very marked, and the curve ends in 1911 at a level of 128, equivalent to a rise of 28 per cent on the 1900 standard.

Diagram III. shows the curves for Austria, Italy and Norway, and calls for little comment. Italy and Norway benefited by a decline in food prices in the years 1902–1906. Since the latter year the rise has been steady but not very large, the curves ending at the levels of 119 and 120 respectively. In Austria the rise in food prices has been more marked and continuous, the increase being equivalent to 35 per cent in the 12 years.

Diagram IV., which gives the curves for the three most important colonies of the United Kingdom—Australia, Canada and New Zealand—is extremely interesting, and deserves close study and attention. Each of these colonies produces and exports food to the mother country in large quantities, and one would expect to find that the rise in food prices in these food-producing countries was less marked than in the United Kingdom or in the other industrial countries of Europe. In one case only is this so, namely, Australia, for up to 1911, the price curve for this colony had only attained a level of 103, and for the whole period the average has been 103½ In New Zealand the course of prices has been more irregular, and the curve rises to 109 in the years 1902–1903, and attains its maximum of 117 in 1908. The course of prices in New Zealand has thus shown a greater average percentage increase than in the United Kingdom. The price curve for Canada is, however, the most remarkable, for in this country the increase in the cost of food has been more marked than in any of the industrial or manufacturing countries, and the curve has steadily ascended until it attained the extraordinary level of 151 in the year 1912, or a rise of 51 per cent as compared with 1900.

Placed in the order of their "dearness" as regards the cost of food (in 1911 or 1912) we thus have the following list of countries: Canada, 151; United States, 139; Japan, 138; Austria, 135; Belgium, 132; Germany, 130; Holland, 123, Russia, 121; Italy, 120; Norway, 119, New Zealand, 116, Australia, 116; United Kingdom, 115; France, 115. A study of the curves given in Diagrams I. to IV. and of the summary of their meaning given above indicates therefore that during the past six years there has been in all countries (agricultural as well as industrial) a very marked rise in the price of food, and also that so far as the figures are available, the increases in the years 1911, 1912, 1913 have been greater than in any previous year.

The Causes of the Increased Cost of Food.

The causes of the increased cost of food in all countries, that is so clearly indicated in Diagrams I. to IV., are not perfectly understood and the opinions of economists are sharply divided upon this question. There are many who believe that the continued growth of the population of the world, the increased demand for luxuries, and the extravagant way in which the present generation is exhausting the material resources of the earth, is beginning to have its effect upon prices. Food and the other commodities of life are dearer, in the opinion of this school of economists, because, in relation to the increasing numbers who want them, they are becoming more scarce.

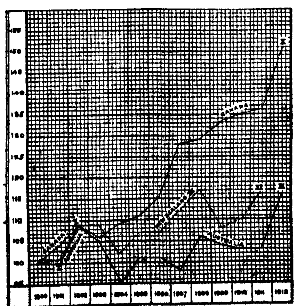


Fig. 4.—Diagram to show changes in the level of food prices in the three most important British colonies: Canada, Australia and New Zealand, during the period 1900-1912.

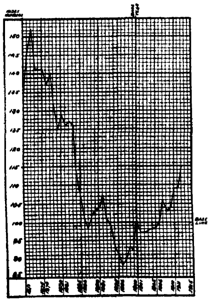


Fig. 5.—Diagram to show changes in the level of wholesale prices of forty-seven articles in the United Kingdom, 1871-1912.

This view finds expression in the presidential address of Prof H N. Dickson, before the members of the Geographical Section of the British Association, at Birmingham, England, in September last. In this address Prof. Dickson stated that "he had no desire to sound an unduly alarmist note, or to suggest that we are in imminent danger of starvation, but it would be well, even on the suspicion, to see if our information is adequate and reliable, and if our conclusions are correct, and not merely to drift in a manner which was justifiable enough in Saxon times, but which, at the rate things are going now, may land us unexpectedly in difficulties of appalling magnitude."

In support of this view, it must be noted that the population of the whole world is increasing by 20,000,000 persons annually, and that as water covers three quarters of the earth's surface, there is only one fourth available for the support of human life. The following quotation from a recent article by Mr. Chiozza Money, an English liberal political economist, emphasizes the teaching of Prof. Dickson's address, and will be read with especial interest in America:

"All mankind has for a basis no more than about 50,000,000 square miles of land, no small fraction of which is desert territory, or for other reasons uninhabitable. The parts of the world which are particularly favored in point of power supplies, whether of coal or mineral oil, or water, are few The easily-worked mines of iron, copper, tin, lead, zinc, etc , have been already creamed, with results which have made themselves evident in price As to timber, the world is using it much more quickly than it is growing it, and we have the extraordinary fact that the United States of America, which has some of the finest forests in the world, has hacked away at them so rapidly, that some sorts of wood are scarce in her vast territory."

The opposite view that food and other commodities are dear because gold has become more plentiful, finds its strongest advocate in Irving Fisher, Professor of Political Economy at Yale University. In an article upon "The Monetary Side of the Cost of Living Problem," contributed to volume 48 (July, 1913) of the *Annals* of the American Academy of Political and Social Science, and in a paper contributed to the Birmingham, England, *meeting of the British Association*, Prof. Fisher gives many reasons and arguments for believing that the present rise in prices is due to an inflation of money and credit, rather than to a scarcity of food and other commodities. His chief argument is based on the fact that the periods of high prices in the past have always coincided with some fresh discovery or more active exploitation of the gold resources of the world, and that periods of low prices have likewise coincided with a lull or setback in the production of the precious metals.

The following paragraph summarizes this argument:

"The rise in prices during the last fifteen years has not only been *great*, but general It applies to *almost* all commodities and to all countries for which we have figures If practically all the children in a certain school were stricken simultaneously with typhoid fever, we should reasonably suspect that there was some common source from which the germ had come If the prices of most commodities rise somewhat simultaneously, we, very reasonably, it seems to me, should attribute this rise to a common factor, rather than to various isolated causes relating to the commodities separately considered. In other words, on the basis of probabilities, it is reasonable to assume that the present general rise in prices is related to *some* common fact Since every price is tied to gold, and the supply of gold has increased during the last fifteen years, we would not then be unreasonable in suspecting, if not convicting, that fact of being responsible for the present high prices. No other important common cause has been suggested."

In his British Association paper, Prof. Fisher pleads for the appointment of an International Conference on the subject, a bill for which passed through the United States Senate last Spring, and states that this proposal has the support of the President and ex-President of the United States, and also of many high officials in the European capitals.

In the present writer's opinion, the increased prices of food and other necessaries of life may be, with some show of reason, attributed to a combination of the above two causes. The increased demand arising from the growing population of the world, and increase of luxury, have no doubt enormously stimulated the call for food and commodities of all kinds. At the same time, the increased output of gold and greater use of credit have *tended to cheapen these, in their relation to commodities*, and, therefore, one has to pay more in gold or silver to obtain the same amount of food than five or ten years ago. Which of these causes has had the most influence in bringing about the rise of the past five years, the writer will not attempt to decide.

Is the Rise in the Price of Food and Other Commodities Likely to Continue?

The question headlined is, of course, the practical one that all affected (either as buyers or sellers) by the recent rise in values, wish to have answered. The only figures that bear upon this question are those contained in the British Board of Trade Report already *referred to*, and they represent the course of wholesale prices of 47 articles of consumption in the United Kingdom from 1871 down to the present date—the year 1900 being employed as base year with a value of 100, and the values being expressed as before—as index numbers, in relation to that base. Diagram V. gives these values in the form of a curve, and the diagram certainly conveys little comfort to those who have been heavily handicapped by the rise in prices since the year 1900. Compared with the prices ruling in the United Kingdom from 1870 to 1880, present prices are low, and if history is to repeat itself, *many years will elapse before the maximum point of the* curve is attained, and the descent to a lower price level is commenced. Many things have changed however in the conduct of commerce and industry since the years that followed the Franco-German war, and it is quite possible that an analogy from the past, in this case, is an unsafe guide to the course of future events. That some high authorities believe that an era of high prices is before us, is proved however by the following extract from the British Association paper by Prof. Fisher:

"The outlook seems to many of us to indicate that the rise in world-prices is permanent, and is likely to be aggravated in *future years*. Under these circumstances, even though we cannot immediately apply remedies for lack of sufficient agreement, the sooner we can secure the necessary data to lead to such an agreement, the better."

Conclusions.

In view of the vast importance of the subject with which this article deals, there can be little doubt that Prof. Fisher's demand for the calling together of an International Congress to consider the problem is wise and timely, and will ultimately be adopted. As Prof. Fisher points out·

"The *great conflict of opinion at the Conference* will doubtless be as to whether the rise of prices means an inflation of money and credit or a scarcity of goods. If the result of its investigations should indicate that the rise of prices is chiefly a monetary phenomenon, this would indicate the importance of a monetary remedy, such as some plan for 'standardizing' monetary units, i. e., 'stabilizing' the general level of prices. But whether or not any such far-reaching remedy can be applied or even recommended, there are other and less ambitious remedies in the way of saving waste which ought to be carefully considered. Such, for instance, are the conservation of natural resources; the elimination of unnecessary middlemen; the introduction of co-operation where economies can thereby be effected; improvement of banking systems; removal of high tariff walls, etc."

An International Committee for making a geographical survey of the world's treasures of material wealth, as outlined in Prof. Dickson's British Association address, might also be appointed, and thus a general "stocktaking" of the earth's natural resources be carried out at the same time that the *important* problem of the rise in prices is being investigated. The writer of this article supports both proposals, and trusts that during the next twelve months some progress will have been made in obtaining the co-operation of statesmen in the leading manufacturing countries for this important work.

TABLE I INDEX NUMBERS OF THE CHANGES OF LEVEL OF FOOD PRICES IN THE PERIOD 1900–1912

Country	Nature of Index Number	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912
United Kingdom	Retail prices of 23 articles of food in London weighted according to workmen's consumption	100	100	101	103	102	103	102	105	108	108	109	109	115
France	Retail prices of 24 articles of food (including wine), fuel and lighting materials in Paris, weighted according to workmen's consumption .	100	100	95	98	99	97	95	100	102	100	104	117	115
Germany	Retail prices of 13 articles of food in Prussia, Bavaria, Baden and Wurtemburg, weighted according to workmen's consumption	100	103	106	105	105	114	118	116	116	124	127	128	(130)
Holland	Retail prices of 23 articles of food in 6 principal towns (unweighted) .	100	100	100	102	103	102	103	105	107	109	115	117	128
Italy	Contract prices of 14 articles of food supplied to 43 State colleges in various parts of the country (unweighted) .	100	100	90	99	97	99	90	101	105	112	114	118	120
Norway	Retail prices of all articles of food (26 specified) in Christiania weighted according to workmen's consumption . . .	.	100	99	99	97	100	103	108	109	106	108	111	119
Russia	Wholesale prices of 30 articles of food at representative markets (unweighted) .	100	104	107	102	104	112	116	130	130	127	116	121	. . .
United States	Retail prices of 15 articles of food in 39 principal cities weighted according to workmen's consumption .	100	105	111	111	113	113	117	122	126	133	140	130	.
British Dominions Canada	Wholesale prices of 78 articles of food (including fodder) at representative markets weighted according to national consumption . . .	100	104	109	106	109	111	115	128	129	133	135	130	151
Australia	Retail prices of 11 articles of food (besides soap, starch, washing blue, kerosene and candles) in the 6 capital cities, weighted according to national consumption		100	109	105	95	101	101	98	106	104	108	103	116
New Zealand	Wholesale prices of 17 articles of food at representative markets (unweighted)	100	101	109	109	102	107	107	112	117	108	110	116	. . .

The Biggest Bird That Ever Lived

By R. W. Shufeldt, M. D.

DURING the Summer of 1913, while engaged in describing and photographing the specimens representing the fossil remains of vertebrates in the extensive collections belonging to the American Museum of Natural History, the United States National Museum, and the Peabody Museum of Yale University, I met with the fragments of the lower long leg bones that belonged to an extinct bird of enormous size. They were completely fossilized, and had been discovered by a member of the Expedition of 1912 sent out by the American Museum of Natural History in the Wasatch of Wyoming. Geologists are pretty well agreed that this particular region is some 2,500,000 *years old*.

These fossil remains consisted of two immense toe-joints and parts of the trochlea of the tarso-metatarsus of an adult individual. The tarso-metatarsus in a bird's leg is the last of the three of the long bones of that limb; the trochlea are those projections at its distal end which articulate with the toe-bones.

This was all that had been found of a bird giant which had flourished over two and a half million years ago in the central region of this country. It was not all that we knew about it, however; for, many years ago, the late Prof. Cope had described, in the *Proceedings* of the Academy of Natural Sciences of Philadelphia (1876, II) and subsequently in the Report of the U. S. Geographical Survey West of the 100th Meredian (Vol. IV, p. 70), the fossil remains of a bird of gigantic proportions, of which he said that "this species was of large size, the proximal end of the tarso-metatarsi being nearly twice the diameter of that of the ostrich. Its discovery introduced this group of birds to the known fauna of North America, recent and extinct, and demonstrates that this continent has not been destitute of the gigantic forms of birds now confined to the Southern hemisphere fauna." This distinguished palæontologist named this long-extinct species *Diatryma gigantea*, and considered it to be quite distinct from any of the existing true ostriches.

We know that an old male African ostrich will grow to be at least eight feet tall, and Cope surmised, in his description of *Diatryma gigantea*, that it was a bird twice the size of an adult ostrich; in other words, it may have attained a height of some fifteen or sixteen feet, or about three times the height of an ordinary man.

It would seem to have belonged somewhere in the group of great flightless birds with keelless sternums known as the *Ratitæ*, or in the Supersuborder *Dromæognathæ* of my own Classification of Birds. Doubtless it was ostrich-like in appearance while not directly allied to that genus, or still less to the moas of the New Zealand group of islands, of which there were some twenty species, now all extinct; of these *Dinornis maximus* was, without doubt, a bird that grew to be at least twelve feet tall, or four feet taller than the tallest of existing ostriches (Newton).

Upon comparing the fossil remains of this extinct bird of ponderous proportions, belonging to the American Museum of Natural History, with those of Cope's *Diatryma gigantea*, I at once recognized the fact that it, too, belonged in the same genus or the genus *Diatryma*, and I have since bestowed upon it the name *Diatryma ajax*. Upon measuring the bones and fragments of bones representing it, it was apparent that these were from a form considerably larger than Cope's *D. gigantea*, and could such a thing ever have happened as to have an old male African ostrich stand beside a full-grown individual of this extinct, gigantic bird of the Eocene of Wyoming, the former would have appeared, by way of comparison, a veritable pigmy in its proportions.

In order to appreciate the probable *size of Diatryma ajax* I have made a drawing for the purpose. The ac-

accompanying illustration is based on that drawing.

The representation of *D. ajax* here shown is intended merely to give its size and *height* as compared with an ostrich and a man, and in no way intends to be a *restoration of this species*; for, up to the present time, we have not the required fossil bones of either *D. gigantea* or *D. ajax* to give us any idea as to the *forms* they had. The illustration is merely a generalized ostrich form to give the reader an idea as to how it would have towered above any one of us or above an ostrich. As here represented, *D. ajax* would have been a bird about twenty feet in height, but if the shafts of the long bones of the leg were fashioned as they are in an ostrich and not as in a moa, it could easily have been a much taller bird than that—that is, it could have attained a height of between twenty-five and thirty feet.

Diatryma ajax, the extinct, ostrich-like bird of the lower Eocene of Wyoming, was a much larger and taller bird than Cope's *Diatryma gigantea*, and what is more, it towered above the *Dinornis maximus* of New Zealand, which was, for many years, the tallest extinct bird known to science.

The Decision in the Kodak Film Case

ON September 9th, 1913, an interlocutory decree was handed down in the case of the Goodwin Film and Camera Company against the Eastman Kodak Company. The question at issue was the validity of patent 610,861, granted to Hannibal Goodwin on September 13th, 1898, for "improvements in photographic pellicles and processes of producing the same," in other words, nothing more or less than the well-known kodak film. The court upheld claims 1, 6, 8 and 10 of the patent. The Eastman Kodak Company appealed from the decision, but on appeal the United States Circuit Court of Appeals for the second circuit affirmed it. The decision, written by Judge Coxe, upholding, as it does, a patent which covers a process that forms the basis of an enormously wealthy industry, is of such importance that we publish, in the following paragraphs, an abstract of it.

Hannibal Goodwin was a clergyman residing at Newark, New Jersey, for thirty years prior to his death, which occurred December 31st, 1900. His salary was small, and for ten years prior to his death he had no regular charge. He was interested in chemistry and spent much of his spare time in chemical experimentation and research. The necessity for a transparent, sensitive pellicle for use in roller cameras had long been felt, and Goodwin, though hampered by his inadequate surroundings, undertook the task of supplying it. The patent specification points out the manifest objections to supports of glass and of paper in combination with gelatin and other substances, and proceeds to state how they may be avoided. The patentee says:

> "I have provided a pellicle the principal ingredient of which is nitrocellulose, or any equivalent . . . which is transparent, and insoluble in the usual developing, fixing and intensifying solutions or liquids used in photography. . . . In carrying out the invention, I provide a suitable surface, such as that of glass, and flow over the same a solution of nitrocellulose dissolved in nitrobenzole or other non-hydrous and non-hygroscopic solvents . . . and diluted in alcohol or other hydrous and hygroscopic diluent."

When dry, this solution forms a flexible transparent sheet or pellicle which is insoluble in any of the fluids employed in dry plate photography. The foil when stripped from the glass constitutes a supporting pellicle for the sensitive film. The specification states further that previous efforts to provide a transparent and flexible pellicle have been failures because they did not possess the properties of glass and were incapable of resisting the usual developing, fixing and intensifying solutions used in photography.

Hannibal Goodwin claimed that he had produced a film which is capable of resisting such fluids and of sufficient smoothness, hardness and toughness of surface for service in a roller camera. He said that in carrying out the invention he provides a suitable surface such as glass and flows over it the solution of nitrocellulose (as distinguished from "commercial celluloid") dissolved in nitrobenzole or other solvent not containing or capable of absorbing water. The equivalents for nitrobenzole are acetate of amyl and those non-hydrous, non-hygroscopic fluid solvents of nitrocellulose which do not mix with water, are not greasy, and are of slow volatility. Nitrocellulose when so dissolved and flowed over a smooth plate produces a smooth, transparent, imporous, impermeable film capable of being subjected to the photographic fluids without being affected thereby. It is further stated that the solution thus obtained by dissolving the nitrocellulose is diluted with alcohol or other similar diluent which serves to dilute or expand the volume of the dissolved nitrocellulose or increase its fluidity. The diluted solution is then applied to a smooth and hard surface, from which it may be stripped when dry.

The claims in controversy are as follows:

> "1. An improvement in the art of making transparent flexible, photographic-film pellicles, the same consisting in dissolving nitrocellulose in a menstruum containing a hygroscopic element and an element which is non-hygroscopic, the non-hygroscopic element being, of itself, a solvent of nitrocellulose, and of slower volatility than the hygroscopic element, depositing and spreading such solution upon a supporting-surface, and allowing it to set and dry and harden by evaporation, and spreading a photographically-sensitive solution on the hardened film, and drying the film, substantially as set forth."
>
> "6. An improvement in the art of making transparent flexible and elastic photographic pellicles, the same consisting in dissolving nitrocellulose in an eventual celluloidal menstruum which is anhydrous and non-hygroscopic, spreading such solution upon a supporting surface, allowing it to dry and harden, spreading photographically-sensitive matter, thereon, and again drying and stripping the pellicle from said support, substantially as set forth."
>
> "8. The process of making photographic pellicles, which consists in subjecting nitrocellulose to the action of a menstruum combining fast and slow evaporating solvents, the slow evaporating solvent being non-hygroscopic and non-greasy in nature and quality, and acting as an eventual solvent as described, spreading the solution upon a support and setting the same by evaporation, then applying photographically-sensitive matter and stripping, all substantially as set forth."
>
> "10. As a new article of manufacture, a transparent film-support for photographic purposes, the same consisting of a thin, non-greasy, film, foil or pellicle of a dried and hardened celluloidal solution of nitrocellulose, combining in addition to the following essential properties of glass-plate supports, viz., insolubility in developing fluids, insensibility to heat and moisture, imporosity of structure, and hardness, smoothness, and brilliancy of surface, the further desirable properties of exceeding thinness, lightness in weight, toughness in texture and elasticity in flexure; as and for the purposes specified."
>
> "12. The process of manufacturing photographically-sensitive pellicles, consisting of flowing a non-photographically-sensitive solution of nitrocellulose dissolved in a non-hygroscopic liquid, or a liquid which is eventually non-hygroscopic and drying and hardening such compound into a support for the photographically-sensitive emulsion and imposing on such support the said sensitive emulsion, substantially as set forth."

Claim 10 covers the film support as a new article of manufacture, and the other claims cover the process by which the pellicle is produced.

An examination of the first claim will demonstrate sufficiently the various steps of the Goodwin process for making a transparent, flexible photographic-film pellicle.

At the time of Goodwin's invention, the art was vehemently demanding, as a substitute for the glass plates then in use, a transparent photographic film capable of supporting the sensitive emulsion necessary in photography, and also capable of being rolled up. Goodwin entered the field as an inventor, for the sole purpose of overcoming the difficulties then existing, and he did so when, speaking broadly, he discovered the process of dissolving nitrocellulose in a menstruum containing nitrobenzole and alcohol or their equivalents, and then spreading the sensitive emulsion on the hardened film. He was subjected to almost unprecedented delays and disappointments in the Patent Office, which it is unnecessary to consider in detail, but he held tenaciously to his original conception of the invention.

There is no proof in the record to support the contention that his process was known by others prior to the date of his application. On the contrary, the necessity for the patented pellicle became more and more apparent and the demand for it more and more insistent, and many efforts were made to meet the demand, but with partial success only.

In 1887 an article appeared in the *Photographic Times Almanac* in which a well-known authority on photographic subjects, Andrew Pringle, points out the pressing needs of the art in language which is prophetic of the Goodwin invention. He says:

> "When we get a support such as I have indicated, transparent, flexible, and in lengths, tourist photography will make a stride that will throw into obscurity all previous advances."

And yet at the time this article was published, there was in the Patent Office an application showing that this stride had actually been taken.

It is unnecessary to advert to the other evidence in the record showing priority of invention in Goodwin. In addition to the presumption arising from the patent itself, we have his clear description of the process which any intelligent chemist would understand and which, if followed, must produce the desired film. Stripped of the unnecessary technical verbiage, which was largely produced by the proceedings in the Patent Office, Goodwin's statement is so plain that it would seem that a neophyte might follow the instructions successfully.

Goodwin's application, as filed in 1887, disclosed, for the first time, the fundamental and essential features of a successful, rollable film. Nothing in the prior art shows Goodwin's process and the proposition that any skilled chemist, familiar with the art as it existed prior to May 2nd, 1887, could construct the Goodwin pellicle cannot be maintained. The defendant's brief says.

> "The Eastman Company, in 1888, devised and introduced its first 'Kodak' camera. . . . This 1888 Kodak . . . marked the beginning of amateur photography."

but it is not pretended that a film other than one having a paper support coated with sensitized gelatin, was used prior to Goodwin's invention, or, indeed, prior to May 2nd, 1887. The proposition that these paper films were used because they were inexpensive and thus available for trying out the film-roll system is not persuasive.

The Eastman Company did not commence its experiments, looking to the substitution of pyroxyline for paper, as a film support, until the latter part of 1888. These experiments were continued by Henry M. Reichenbach, the company's chemist, until February, 1889, and on April 9th, 1889, he filed his application for a patent as assignor to the Eastman Dry Plate and Film Company, and promptly received a patent dated December 10th, 1889. During all this period beginning with the experiments and ending with the patent, Goodwin's application was lying in the Patent Office. It may be that his process was an improvement on Goodwin and that during the life of his patent he was entitled to the exclusive use of such improvement, but it can have no retroactive effect, it cannot destroy or limit an invention which was *in esse* before his invention was conceived.

There is no evidence that anyone ever did make the Goodwin pellicle prior to his invention, and the court was convinced that no one could have made it by following the direction of Parkes or David (cited in reference of the defendant).

It is unnecessary to consider the question of invention in all the details pointed out in the defendant's briefs, for the reason that Goodwin was the first to dissolve nitrocellulose in nitrobenzole or its equivalents diluted in alcohol or its equivalents. This being so, his patent is entitled to a construction broad enough to enable its owner to reap the profits which naturally and fairly belong to the invention. The invention is one of more than ordinary merit, and the claims should not be so construed that anyone may safely infringe who has wit enough to substitute equivalents for the elements named in the patent, and to add or subtract therefrom, so long as the menstruum contains a hygroscopic and a non-hygroscopic element, the latter being a solvent of nitrocellulose and of slower volatility than the former. If the defendant uses a process having these elements, it matters not what else it uses or that its method is an improvement on the patented method.

It is not necessary to enter upon a discussion of the Reichenbach interference further than to say that this, as well as most of the complications in the case, would have been avoided had the Goodwin patent gone to issue in due course, as it should have done. The long delay and the contradictory rulings of the Patent Office would have discouraged an inventor who had not supreme faith in the justice of his cause. If Goodwin made a generic invention it follows that he is entitled to hold as infringers those who used the equivalents of nitrobenzole and alcohol. In the process of the patent and of the defendant nitrocellulose is used. In both it is dissolved in a menstruum containing a high-boiling, non-hydrous, non-hygroscopic solvent like nitrobenzole or its equivalents and a diluent like alcohol or its equivalents. In both the processes of the defendant, nitrocellulose is dissolved in a menstruum consisting of a high-boiling, non-hydrous, non-hygroscopic solvent and a diluent of wood alcohol. In the process of 1898, the solvent was amyl-acetate 5 parts, fusel oil about 16 parts and camphor 3 to 5 parts. The diluent was wood alcohol 104 parts. In the 1902 process, the solvent was fusel oil 16 parts and camphor 3 parts. The diluent was wood alcohol 40 parts and acetone 40 parts. There can be no doubt that the defendant uses nitrocellulose and the diluent of the patent, viz., alcohol—wood alcohol being expressly referred to in the patent as an example of a diluent having a low boiling point and a relatively quick evaporating quality. The only debatable question relates to the equivalency of the defendant's solvent and it cannot be doubted that the combination of fusel oil, camphor and amyl-acetate of 1898 process and the fusel oil and camphor of the 1902 process are equivalents of the high-boiling, non-hydrous, non-hygroscopic solvent of the patent. It matters not that the defendant's process produces better results than that of the patent. Assuming this to be true, it does not give the defendant the right to use Goodwin's discovery because it has introduced improvements. It would be strange, indeed, if during the fifteen years which elapsed from the date of the Goodwin application to the adoption of the 1902 process there had been no progress in the art. Undoubtedly there was progress, but one cannot use a patented invention because he has improved it.

Goodwin was the first to produce a transparent sensitive pellicle for use in roller cameras. The conclusion naturally follows that his patent is entitled to a liberal construction. Doubts should be resolved in its favor, and care taken not to confuse the art at the date of issue with the art as it existed at the date of the application, eleven years before. So considered and construed, the claims in controversy are valid and infringed.

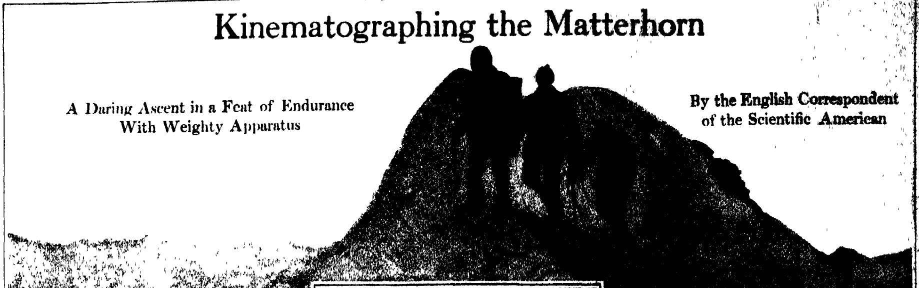
A Bottle-stopper that Locks

A BOTTLE stopper that locks is a recent Paris idea, and will be very useful for keeping fine liquors and the like out of the reach of persons for whom they are not intended. It can also be used for protecting inflammable or dangerous liquids so as to avoid accidents. A metal cap fits over the bottle neck, and it has a small felt-lined collar inside which serves to fit around the rim of the bottle. The collar is pressed on by turning a winged nut, and when all is in place, a small arm comes down alongside the wing of the nut so as to allow of running a padlock through the two holes. This prevents any turning of the screw and keeps the bottle tight shut.

Kinematographing the Matterhorn

A Daring Ascent in a Feat of Endurance With Weighty Apparatus

By the English Correspondent of the Scientific American



Starting upon the descent from the crest.

AMONG the many peaks forming the Alpine chain of Switzerland, which are so familiar to the tourist, the Matterhorn never fails to compel attention from its peculiar pyramidal formation, jutting in stately loneliness above its rugged fellows. It is a peak which possesses unfathomable fascination to the mountaineer, owing to the extreme difficulty and danger in scaling its crest, and because of the atmosphere of tragedy with which it is invested. It was not until July, 1865, that its topmost rock was trodden by human feet, and that pioneer effort made by Whymper proved most disastrous, inasmuch as four of the party fell 4,000 feet and were dashed to pieces.

Although, since that tragic year the mountain has been scaled upon numerous occasions, yet it is a feat which must not be attempted by any but the most experienced climbers, and then only with the assistance of thorough expert guides The latter, cognizant of its fearful steep precipices and menacing crags, will not essay the attempt unless the mountain is in first-class condition, and the weather is fine. To-day the peak, which rises to an altitude of 14,705 feet, may be ascended upon three sides, and the route followed is determined by prevailing conditions. However, it is by no means unusual for a party to be held up for three or four weeks by adverse weather conditions upon the higher reaches, and, frequently, an expedition has to be abandoned entirely, owing to the brief duration of the climbing season

Therefore, when Mr Frederick Burlingham of the British and Colonial Kinematograph Company, who is himself an expert climber, intimated his intentions to make an ascent and to kinematograph the peak during the climb, his proposal was received with ridicule. At least two days would be involved in the task, and there was every possibility of the party becoming stalled, in which event a serious situation would be precipitated Then again, the weight of the apparatus necessary for taking the "movies" served as an additional deterrent The majority of climbers, owing to the difficult character of the ascent refuse to be hampered in any way whatever; they even will decline to take a snap-shot camera with them

The kinematographing suggestion certainly was somewhat daring, inasmuch as bulky and weighty apparatus would be unavoidable Mr. Burlingham secured the lightest and most reliable instruments he could find, but even then the weights could not be kept down very much The camera itself weighed 33 pounds, the tripod 22 pounds, while the film and spool boxes brought the complete weight to nearly 70 pounds. This was above that which was absolutely indispensable in the outfit to be carried, such as ropes, extra clothing, provisions, and refreshment.

The operator secured the assistance of two of the most reliable guides in Switzerland. The leader, Gabriel Zumtaugwald, accompanied Mrs Bullock Workman on her expedition to the Himalayas, while Heinrich Julen was familiar with the Swiss mountains through and through. In addition, two first-class porters, who were also expert climbers, accompanied the party to carry the apparatus, and they all succeeded in accomplishing a feat of endurance which has never been equalled in the playground of Europe.

The guides and porters, although willing to make the attempt, frankly stated their convictions that the effort would prove a failure, and did not hesitate to point out the many and extreme dangers attending the task. However, the operator would not be dissuaded, and accordingly the itinerary was mapped out very carefully.

Climbing the "shoulder" of the Matterhorn.

It was decided to climb the mountain upon the Zmutt side and Zermatt (5,315 feet) was selected as the starting point. Here the party remained, watching the barometer and the behavior of the weather on the mountain top. For two days the crest was assailed by a terrific gale, which blew away the freshly fallen snow in clouds, and this tempest was followed by two days of perfect sunshine. The barometer standing very high and steady, the party decided to start on July 1st, and to push ahead so as to gain the Matternhorn *cabine* at 10,745 feet the same day, and to spend the night in this elevated hostelry.

In order to conserve the energies and endurance of the porters, it was decided to load the equipment upon three mules and to drive them as far as possible up the mountain side. They started off amid the cheers of a huge crowd.

The going at first was easy, the party reaching the Schwarzsee hotel, having luncheon and leaving at 1:30. The path lay over the dangerous Hörnli ridge. This trail winds along the brink of forbidding precipices, and, at the most awe-inspiring places, moving pictures were taken to demonstrate the partiality of the mules for the outer edge of the trail, which has often been described, but which those who have never been on a mule's back among the mountains scarcely can believe. The explanation however is simple. The animal takes the more dangerous-looking part of the narrow path merely to prevent his load knocking against the mountain wall on the inside.

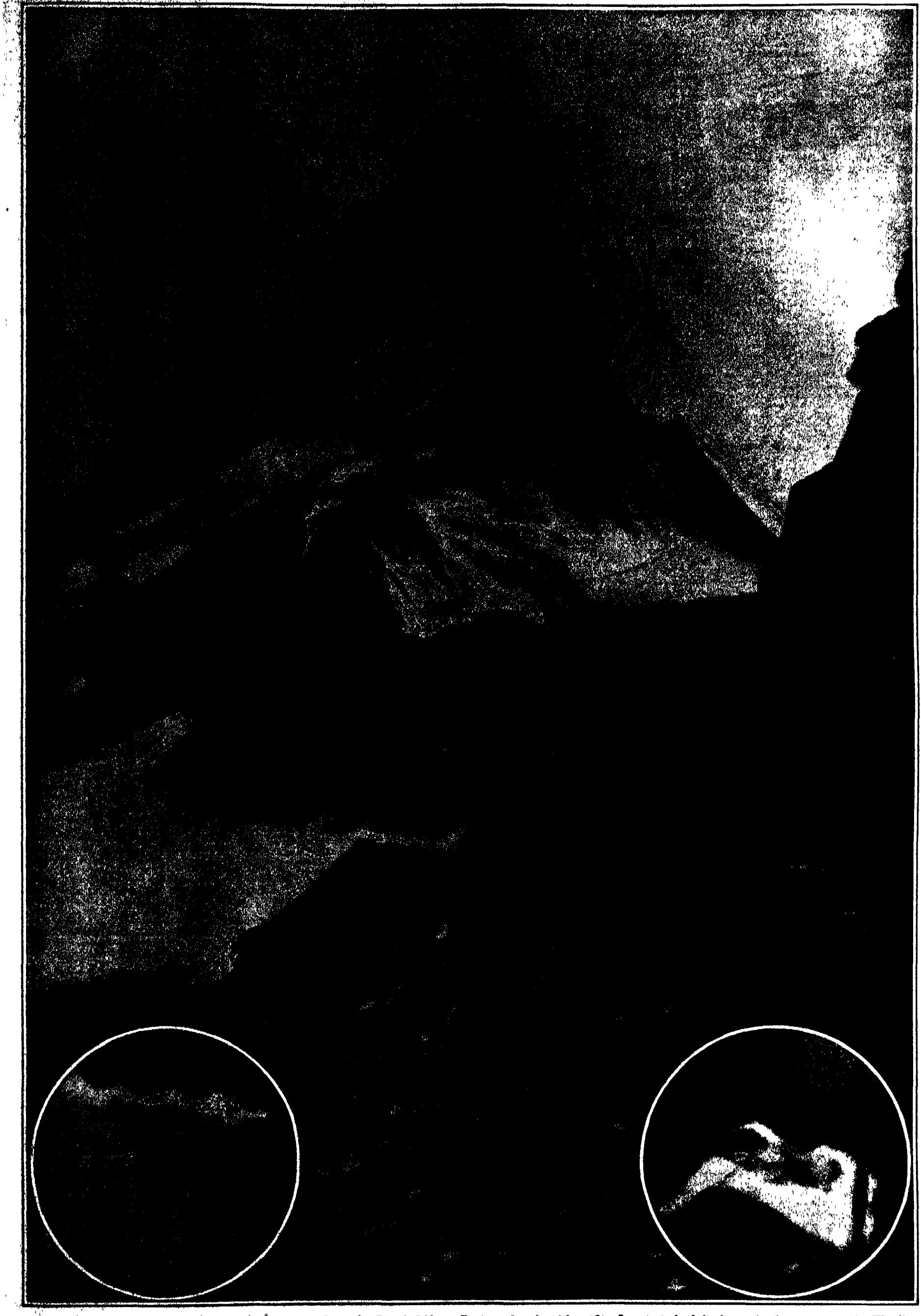
The party did not succeed in traversing the Hörnli ridge very far by animal effort. First two mules were turned back, and the journey resumed with one. But the snow became so deep that this animal floundered hopelessly, and at last, was abandoned, the two porters shouldering the weighty and cumbersome apparatus, while the others assumed their proportions of the remaining equipment. Progress was somewhat slow as the ridge was covered thickly with snow and ice, and this state of affairs did not augur well for the attack upon the peak proper the next day.

Although the going was difficult the *cabine* was reached early in the afternoon. This hotel, at more than 10,000 feet above the sea, is impressive in its loneliness, and like all elevated hostelries provided essentially for the convenience of the daring, has its own peculiar tariff. The room costs $5 a night if no food is supplied, but if the latter is partaken beneath its roof, and charged extra, the cost of the room is $2.50. But, seeing that every ounce of provisions as well as wood has to be brought up by porters, and taking into consideration the limited number of guests, the charges are not high.

The climb proper was commenced early the next morning, the party setting out at 2:30 A. M.—an hour later than had been arranged. The stars were shining brightly, the wind had blown itself out, but the cold was intense. Roped up and armed with lanterns, the party proceeded to make their way up the ice-covered crags. Climbing amid such dangerous surroundings, the flicker from a hand lantern produces strange sensations in the mind of an amateur, but to the experienced mountaineer it offers little disadvantages, although a few minutes must elapse before one becomes accustomed to the glimmer. The party soon found that the peak was far from being in a condition conducive to rapid traveling, as, in the darkness they had to cut their way step by step through some of the most dangerous places, with a sheer drop of hundreds of feet onto the glaciers looming out indistinctly below.

Despite the hindrances, smart progress was maintained; in fact, the guides themselves urged a slower pace, as the rarified air was somewhat exhausting. Indeed, Burlingham, the operator, lost his breath at this point, and did not regain it full until he once more

(Concluded on page 264.)



Pyramidal aspect of the superb Matterhorn as seen from the Hörnli Ridge. Party and mule with outfit. Insert at the left shows the deep snow on the Hörnli Ridge, where mule had to be abandoned. The one at the right pictures the party at the summit of the peak.

KINEMATOGRAPHING THE MATTERHORN.

The Problem of Our Navy

IV.—The Price We Pay for Self-sufficiency and Unpreparedness

By the Editor

THE present indifference to the naval and military needs of the country is traceable to several causes and conditions, first among which we do not hesitate to place the biased and one-sided historical teaching given to our children in the public and high schools, supplemented, it must even be admitted, by that of some of the text books of our higher institutions.

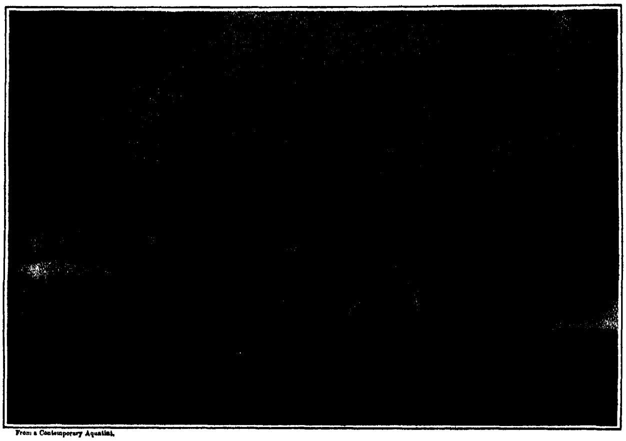
The inculcation of the doctrine of American invincibility begins with the instruction of the American "Schoolmarm"—efficient and worthy though she is—and one lasting result of her patriotic fervor is that the average American youth passes out into the work-a-day world with the deeply-ingrained belief that, since the United States has emerged victorious from every conflict in which it has been engaged, it is practically invincible, and therefore may contemplate any possible wars of the future with the conviction that the defeat of the enemy is inevitable

Nevertheless, *it is a fact that not once in its history has the naval and military strength of the United States been put to the supreme test against a first-class power.*

The war of 1812? No, not even then; for at that time Great Britain was engaged in the stupendous struggle of the Napoleonic wars—she was fighting for her very existance, and the storm center lay not in the New World, but the Old. The Mexican war of 1848 was waged against a feeble State; and not much stronger was Spain in 1898.

The misleading tuition of the schoolroom is subsequently aided and abetted by a perfervid political oratory, under the spell of whose sonorous and impassioned sentences the successes of our wars are apt to be swelled to an importance far beyond their merits, and their failures absolutely ignored.

And lastly, there is the daily press, which seemingly is unable to record the simplest military exploit without suffering from an acute attack of superlativitis, and under whose facile pen an affair of outposts becomes a serious engagement, and a skirmish expands to the dignity of a battle big with the fate of nations



From a Contemporary Aquatint.

" A war of arms, brought on by a programme of peace."—WOODROW WILSON.

Duel between "Chesapeake" and "Shannon."

Some day, someone will write the story of the great battles of the world from the viewpoint of the inefficiency of the losing side When that is done, there will be a sensational readjustment of values. It yet remains for some competent critic, preferably a civilian, to write such a history of the Spanish-American war, and prove how greatly the woeful inefficiency of the Spanish navy facilitated the victories of our own It may be said of the enemy that from the opening gun at Manila to the capitulation at Santiago, he literally "did the things he ought not to have done, and left undone the things he ought to have done." This is well understood by our naval officers. Although the navy lived up to its fine traditions, and both officers and men won every distinction that the opportunities of the war may have offered, we have frequently heard these same officers deplore the fact that the American public was liable to draw exaggerated conclusions from the victories of Manila and Santiago. Thus we learn from "War-time in Manila," a recent book from the pen of Rear-Admiral Bradley A Fiske, who took part in the battle of Manila Bay, that the Spanish admiral might have rendered Dewey's expedition not only futile, but overwhelmingly disastrous, if he had but placed his fleet under the protection of the powerful modern guns of Manila city, instead of under the forts of Cavite. Here is the situation as described in the Admiral's own words:

"Now what would have happened if the Spanish had put their fleet close in front of the city, as we expected they would do? The conditions for firing would have been almost perfect on the solid protected positions of the shore guns. . . . One hit from one of those 9.2-inch guns would have done irreparable injury to any American ship, because no American ship was armored and we had no means of making repairs. Almost any such hit would have sunk the "Petrel" or disabled any of the other ships. . . We should have had to fight a much longer time to destroy the Spanish ships, and during every instant we should have been exposed to a much greater volume of fire. We would have received tremendous injuries. If the Spaniards had done as they should have done, and blown up the machinery in the Arsenal, where would we have gone to repair our injuries? San Francisco was 7,000 miles away. Note.—Since writing the words above, fifteen years have gone by. *My present opinion is, and has been for several years, that if the Spaniards had placed their fleet where it would have been supported by Manila's guns, they would have sunk every American ship. Dewey could not have retreated fast enough to save his ships, after the injuries had once begun to arrive; and even if he could (and would) whither would he have gone?*"

So also at Santiago. Not alone were our ships overwhelmingly superior in size and gun power, but the Spanish admiral, instead of scattering his ships in different directions, as he should have done when he emerged from the harbor, strung them out along a lee shore and in such a position that they could not maneuver. The American fleet was able to choose its own distance and batter the Spanish cruisers to pieces under all the easy conditions of a summer target practice It may be said of the Santiago as of the Manila fight that it was a battue rather than a battle.

Now let it be clearly understood that the facts we have given above are quoted, not with the purpose of detracting from such credit, and there is much of it, as is due our Navy for its overwhelming victories, but merely to establish the truth that never, as yet, has the modern American Navy been put to the supreme test of engaging, with equal forces, a first-class naval power; and that *to imagine we can afford to enter into a future war without matching ship with ship and gun with gun in equal strength and with equal numbers, is to lend ourselves to a delusion and a snare.*

True it is that in the war of the rebellion we established our standing as a great military nation; but so far as that war affects the problem of our Navy, its one great lesson is that of the enormous folly and the stupendous extravagance of our drifting along in a chronic condition of unpreparedness for war.

For if the country had possessed an adequate navy, fully manned and equipped, the war, instead of dragging its weary length through four long years, with their enormous sacrifice of life and treasure, might have been won in six months' time. The South sent out its merchandise and received in exchange the munitions of war through its Southern ports. Had the Government possessed an adequate navy, these ports would have been shut in at once by a strict blockade; and the sheer lack of the munitions of war would have forced the South to a speedy capitulation. As it was, our chronic state of unpreparedness imposed upon the country the gigantic task of creating in time of war both the naval and military forces that were necessary to push the war to a successful issue.

In no sphere of human activity does the "penny-wise pound-foolish" policy demonstrate its inexcusable and costly folly so clearly as in this matter of naval and military preparedness. Times without number, history has proved that an efficient navy is a most economical investment; and that "a war of arms brought on by a programme of peace," as President Wilson has characterized the war of 1812, is a policy of the wildest extravagance.

There have been periods in the history of this country when the provision of the moneys necessary to build, equip and maintain a fleet adequate to its necessities, would have proved to be a venture yielding one thousand per cent on the investment.

Is the statement disputed? Then look at our annual pension roll of $180,000,000—a legacy of our unpreparedness! *The total cost of pensions to date, due to the civil war, has been four thousand millions of dollars—sufficient to have built nine dreadnoughts per annum for the past forty-seven years.* The pension appropriation for 1914 will be about $180,000,000; an annual draft on the Treasury which would suffice to build about nineteen superdreadnoughts.

First cousin to the popular belief that our record in war shows us to be invincible is the equally foolish belief that the mere possession of dollars and men, pride and pluck, suffices to make us a first-class military people. It is positively amazing that in a country which leads the world in the number and excellence of its schools, the magnificence of its public libraries, and the far-reaching activities of its daily press, there should still prevail a widespread belief that the naval and military strength of this country can be expressed in terms of its area and population, the undeveloped resources of its mines, farms, and forests, and the length of its roll-call of multi-millionaires.

How many of the people of this country understand that our vast national wealth in its present undefended condition, and our commanding geographical position, by exciting the cupidity and the jealousy of rival States, are a positive source of weakness and a powerful predisposing cause to a war for which we are ludicrously unprepared.

The day of undisciplined levies and extemporised navies has gone by, never to return; for the trend of naval development in the past few years has been such as to put a heavy premium upon preparedness and a heavy discount upon the mere possession of the raw materials of war. It takes three years to build a battleship and another year to get it into efficient fighting condition; it takes four years to produce an efficient gunner or petty officer, seven years at Annapolis and aboard ship to bring a junior officer up to full efficiency; from twenty to twenty-five years to produce a captain equal to the command of a battleship, and from twenty-five to thirty-five years to produce an admiral equal to the enormously complicated and difficult task of carrying a huge modern fleet successfully through a naval campaign. The naval wars of the future will be short, sharp and decisive. They will be decided just as soon as the far-flung screens of scouts and cruisers have got in touch with each other, and have brought their respective fighting lines of dreadnoughts together. When that has been done, *the fate of the contending nations will be a matter not of days or even of hours, but of minutes. The battle of Tsushima, which brought Russia to her knees, was won in forty-five minutes from the firing of the first gun!*

War is infinitely more costly than battleships; and both history and common sense combine to teach us that there is no agency so potent in preventing war as a battleship line sufficiently strong to preserve the peace. *It is the magnitude and preparedness of the German naval and military forces that has secured to Germany the forty years of unbroken peace, during which that country has so greatly developed its home industries and built up a merchant marine that is the wonder and admiration of the world.* (Thanks to our geographical position we need carry no such burden of military forces as Germany—an adequate navy will give the needed security.) It is the realisation by Great Britain of the importance of the command of the sea as expressed in her magnificent navy, that has made her the dominant world power and maintained her shores inviolate for centuries against the racial hatred and the military ambitions of the great powers of Europe.

The policy which has led Great Britain to build up her enormous navy is a policy not of war but of peace. Had she restricted her naval appropriations as we have done, she would long ago have been plunged into a war, the cost of which, in loss of ships and commerce, would have paid for her navy, great as it is, ten times.

And what of ourselves? Shall we lay to heart the lesson of that stupendous pension roll of $180,000,000 and hasten to bring up our navy to a standard of strength that will insure a lasting peace, or shall we, as in 1812, drift into another "War of arms brought on by a programme of peace?"

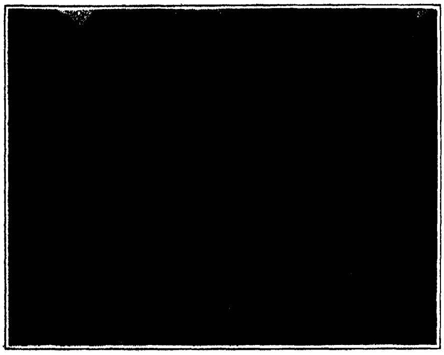
Crossing the River on a Wire

THE primitive bridge herewith illustrated is one which was made for practical use by a party of government surveyors in the Rocky Mountains, and is illustrative of the difficulties which are being constantly met and overcome by such "advance guards of civilization." It consists of two strands of telephone wire, borrowed from the Forest Service, stretched between two trees. The "bo's'n's seat" and "trolley" consist of a loop of the same kind of wire and a billet of wood. The bridge served for the transportation of a crew of men with instruments and supplies for several days work.

Ticket-printing Machine

IN Europe, railroad tickets are now being printed by machine, upon a blank card, the moment they are delivered by the ticket office. The accompanying photograph illustrates a ticket-printing machine that is in use in a number of the large depots in Germany, and in England and the colonies. On the old method, the railroad company had to print and keep in stock a large number of tickets, and as these represented a great money value, they had to be stored and watched closely so as to avoid losses. Now the use of the machine overcomes all difficulties from this cause, for the tickets are printed only at the moment they are called for. When we consider that the machine shown in our photograph is able to hold 4,000 different printing plates, such as are needed for all the destinations, it will be evident that some ingenuity is needed to make up such an apparatus. The carriage which slides along the top is used for the printing, and a blank ticket is fed into a slot in it. Working the top handle causes one of the printing plates to rise up out of the bottom box or cylinder and enter the pointer, it being pressed upon the ticket so as to print it with the destination, price and other data, then another operator withdraws the ticket and hands it to the buyer. In the lower cylinder are numerous rows of plates all around it, and working a pedal causes an electric motor to bring the desired row to the top, at the same time working the name-bearing top cylinder, seen in the rear, by chain drive. The row of names is first brought under the pointer by proper rotation, then the carriage or printer is slid opposite the required name in that row. The carriage is now just over the right printing plate, so that working the handle causes the plate to rise, as we have seen, and allow of printing the ticket.

The cave farm is entered by means of a scow.



Mushrooms thrive in the humid cavern.

Emergency bridge used by Government surveyors.

Flexible-back hack-saw blade supporting a weight of 282 pounds.

A machine for printing railroad tickets as needed.

Farming in a Cave

A CAVE in the heart of the Ozark Mountains of Missouri is the unusual spot chosen for a farm by a retired citizen of St. Louis. While looking about for a farm in the western part of his home State, Mr. Robert Smith found an attractive 26-acre stretch, beneath part of which lay a large cave. Remembering the profitable use made of caves by the mushroom growers of southern France, he determined to test the productiveness of his acquisition.

Preparations for the experiment were simple. He first constructed a 25-foot flat-bottomed boat, for his only practicable access was by a small river running through the cave. Then while his neighbors were digging up weeds and clearing brushwood from their lands, Farmer Smith had to uproot and haul away the stalagmites and stalactites, the lime deposits left by the incessant dripping of water during many centuries. Except for a clayey substance, ocher, which covered part of the walls, the cavern floor was bare limestone, so that the final preliminary activity was to spread soil and manure over the ground.

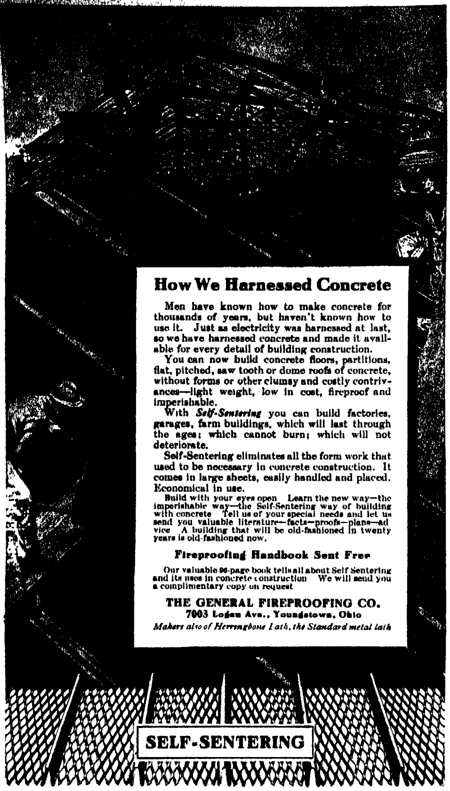
Mushrooms are peculiarly suitable for such a project as the cave farm. The spawn is secured in bricks, which are broken up and scattered over the floor surface From a single mulching, and with almost no care, the farmer can harvest a new crop of marketable mushrooms every day for three months. Allowing a brief period for the fungus to attain its full size, Mr. Smith can readily plant spawn three times each year. From this promising start, the subterranean agriculturist turned naturally to rhubarb and celery. These are planted above ground, and are later transplanted in the cave. The underground ripening causes an unusually rapid growth, the rhubarb gaining on the average an inch a day in length, and also gives the stalks a superior tenderness and a rich flavor

Besides the crops which the Missouri farmer is now producing regularly, the cave, with its fixed quantity of moisture and its temperature which never varies from 60 degrees, is better than a man-made cold storage house for keeping vegetables fresh indefinitely. So quickly did this condition become evident that all the farmers within a radius of 20 miles now store their sweet potatoes in the cave for periods as long as two years

A Remarkable Hack-saw Test

THE accompanying illustration shows a most interesting test of a hack saw in which a flexible-back blade supported two men, one weighing 147 pounds and the other 135 pounds, or a total of 282 pounds, without breaking. It is maintained that the best hack saw should have a soft flexible back with hard or tempered teeth. Often hack saws are operated at about as much as 150 strokes per minute, the operator forgetting that it is action and not speed that does the work. This is one of the most frequent abuses to which shop men subject a hack-saw blade.

The best speed for the blade is claimed to be from 40 to 60 strokes a minute, and no blade will stand higher speed without danger. The exact speed at which a blade should be run depends upon the material being cut. The harder the metal, the slower the speed should be. The operator should run the blade slow enough to feel the teeth take hold, as when filing If a cut must be made quickly, some sort of liquid on the blade such as a soap solution or lard oil should be used.



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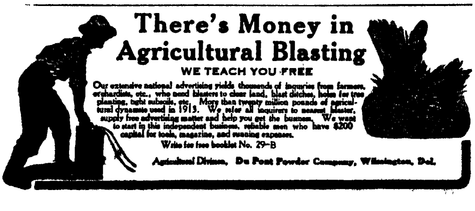

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Kinematographing the Matterhorn

(Concluded from page [illegible])

returned to the lower levels. The guides, although experienced to the conditions, also showed signs of distress, and the weight of the outfit was beginning to be felt. According to the regulations concerning the carriage of baggage upon Mont Blanc, the maximum load permitted per man is 10 kilogrammes (22 pounds): here there was about 50 per cent excess. As a matter of fact, two additional porters should have been requisitioned.

As the sun rose the party reached the abandoned club hut on the mountain. It is merely a box upon a shelf of rock. A second breakfast was partaken, and then it was decided to shed everything that could be spared. Practically all the food—for five—was left at the cache as well as other equipment. Slender supplies of a light wine were carried as there is no possible chance of quenching thirst above the *cabine*.

Beyond the hut comes the stiffest part of the climb: a toil up a 70-degree slope of ice and snow. The leading guide paused, shook his head, and emphasised the dangerous condition of the mountain. But Burlingham would not turn back. They cut steps every inch of the way, and this labor at such an altitude proved so extremely tiring that the advance was now exasperatingly slow. There was the danger that the summit would be reached too late to permit the descent to be made before darkness set in. When the "shoulder," which is a long steep ice slope, was reached, and a violent gale was encountered, the guides betrayed by their faces that they hesitated to go any farther. The air-current was whirling so viciously that it threatened to blow the whole party off the mountain. Moreover, the wind picked up small particles of frozen snow and hurled them against the men with blinding force. As it was, their faces were so filed by these driving granules that the skin was greatly irritated, and the discomfort was intense.

The arrangements provided for a respite of some 15 minutes at this point, but the situation became so alarming that the leading guide braced the party together, and told them to make a rush to the rocks above, where shelter might be obtained. The order was answered, and the kinematographing of this part of the journey conveys a striking impression of the dangers attending the climb. The operator set up his instrument, and one guide, to whom he was roped, used his body as a brace to support the tripod, while with his hands he clung to the operator's knees to prevent his being blown off his perch, and to frustrate any false movement, as the position was on a narrow ledge overlooking a drop of 3,500 feet. In fact, Burlingham became so absorbed in his work as to forget his perilous position, but this was brought home to him in a startling manner. He moved slightly to swing his camera round, and in so doing came to the edge of the precipice. Immediately a huge mass of snow and ice went overboard with a resounding crash, and had it not been for the strength of his assistant he must have gone too

The wind gave no signs of abating. The party had been climbing for 8½ hours, and were still far from the summit. One and all were blowing from their efforts. Zumtangwald took a look round and expressed his opinion that it would be inadvisable to go any farther. Burlingham, with the summit almost within his reach did not relish the prospect, and so, when he remarked "Very well, but if we go back we shall have to make another attempt" his companions decided to push a little farther ahead, and if the conditions did not improve, to retreat. They had no desire to repeat the ascent as its dangers and difficulties had been revealed only too potently.

Curiously enough, after another fifteen minutes' hard toiling, a point was gained above the air current where virtual calm prevailed. Above the "shoulder" there are several permanent cables, knotted rope and wire to assist ascent. By their aid faster progress was made. Gaining the upper level they passed the spot where the four

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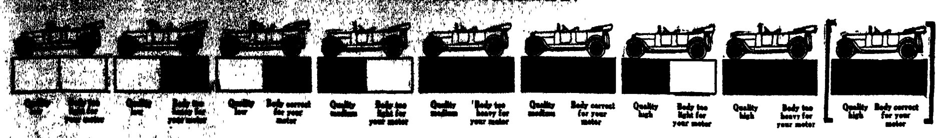
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Body too light for your motor
Quality low
Body too heavy for your motor
Quality low
Body correct for your motor
Quality medium
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Quality medium
Body too heavy for your motor
Quality medium
Body correct for your motor
Quality high
Body too light for your motor
Quality high
Body too heavy for your motor
Quality high
Body correct for your motor

Only 1 oil in 9 is correct for *your* car

That is conservative.

There are two vital factors in automobile motor lubrication. One is the oil's *quality*. The other is the fitness of the oil's *body* for your type of motor.

There are also many variations in the *body* of oils.

Only one is correct for *your* motor.

There are also many variations in *quality*. But under the heat of service in your motor, only one *quality* will show maximum lubricating efficiency.

What if your oil is below the highest *quality* or incorrect in *body*?

Loss of power or undue friction, or both, must result. Repair bills follow.

Consumption of gasoline and oil mounts up.

Two motor demands

You may "want" correct lubrication. But you will seldom get it by chance.

It is of the utmost importance that you find the oil whose *body* suits your motor and whose *quality* offers the highest protection after the oil has been distributed.

It is now generally known that oil of correct body for your car can be determined only by detailed motor analysis—backed by scientific lubricating experience.

How friction hides

We are sometimes asked why incorrect lubrication does not always show up quickly in a motor.

That is an interesting question.

Some years ago motor parts were more exposed. Cars were often under-powered. Noise, overheating and loss of power gave the motorist timely warnings to investigate his lubrication.

But today most motors are amply powered and are largely closed in. Loss of power may not be noticed. Sound is deadened beneath metal jackets. Parts are frequently out of sight and hearing.

It is much like smothering an alarm-clock gong under a pillow.

The *noises* of friction are now partly smothered. But the *friction* still exists.

There is only one safeguard against undue friction—*correct lubrication.*

The solution

As a fundamental step in producing the oils specified in the Chart below we analyzed the motors of every make of automobile. We found widely varying conditions.

Correct lubrication for every type of motor demanded several grades of oil.

Keeping before us the special requirements of gasoline engine lubrication, we manufactured these grades from selected crude stocks.

In our Lubricating Chart we then specified the correct grade of Gargoyle Mobiloil for each car. Every year by fresh analyses and demonstration, this Chart is brought up to date to cover the models for that year.

This Chart, printed in *part* below, for a number of years has been a standard guide to correct lubrication. Our *complete* Chart will be mailed you on request.

Make a note of the grade of Gargoyle Mobiloil specified for your car. Make sure that you secure it—buying preferably in the original barrels, half-barrels and sealed five-gallon and one-gallon cans, marked with the red Gargoyle.

Then there can be no doubt that your oil will be scientifically correct for your car in both *body* and *quality*. You will use the "one" oil essential to the longest life of your car and the greatest pleasure in motoring.

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A guide to correct Automobile lubrication

Explanation: In the schedule, the letter opposite the car indicates the grade of Gargoyle Mobiloil that should be used. For example, "A" means "Gargoyle Mobiloil A" "Arc" means "Gargoyle Mobiloil Arctic." For all electric vehicles use Gargoyle Mobiloil "A." The recommendations cover both pleasure and commercial vehicles unless otherwise noted.

MODEL OF	1910		1911		1912		1913		1914	
CARS	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Abbott Detroit	A	Arc.	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
Alco	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	..	..
American	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc
Auburn (6 cyl.)	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" (4 cyl.)	A	E	A	Arc.	A	Arc.	...	...	...	...
Avery	A	E	A	E	A	A	A	A	A	A
Buick (2 cyl.)	A	A	A	A	A	A	A	A	...	...
" (4 cyl.)	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Cadillac (4 cyl.)	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Cartercar	A	E	A	E	A	E	A	E	Arc.	Arc.
" Com'l.	A	E	A	Arc.	A	Arc.	A	Arc.	...	...
Case	...	...	A	A	A	Arc.	A	Arc.	A	Arc.
Chalmers	Arc.	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.	A	A
Chase	B	B	B	B	B	B	B	B	B	B
Cole	Arc.	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Delaunay-Belleville	B	A	B	A	B	A	B	A	B	A
E. M. F.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	...	...	...	...
Fiat	A	A	B	A	A	A	B	A	B	A
Flanders	E	E	E	E	Arc.	Arc.	...	...	...	...
" (6 cyl.)	...	...	...	...	...	...	Arc.	Arc.	...	...
Ford	A	Arc.	E	E	E	E	E	E	E	E
Franklin	B	Arc.	A	Arc.	A	Arc.	A	Arc.	A	A
" Com'l.	B	A	B	A	A	Arc.	A	Arc.	...	...
G. M. C.	...	...	...	...	Arc.	Arc.	A	Arc.	A	Arc.
Havers 6-44	...	...	A	Arc.	A	Arc.	A	Arc.	A	A
Havers 6-55	...	...	...	...	...	...	...	...	Arc.	Arc.
Haynes	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Hudson	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Hupmobile "20"	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	...	...
" "32"	...	...	...	...	...	...	A	Arc.	A	Arc.
I. H. C. (air)	...	...	...	...	...	...	B	A	B	A
" (water)	...	...	...	...	...	...	A	A	A	A
International	B	A	B	B	B	A	...	...	...	...
Interstate	A	E	A	Arc.	A	Arc.	A	Arc.	...	...
Jackson (2 cyl.)	A	A	...	...	...	...	...	...	...	...
" (4 cyl.)	A	Arc.	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
Jeffery	...	...	...	...	...	...	...	...	A	A
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	A	A

GARGOYLE

Mobiloils

A grade for each type of motor

MODEL OF	1910		1911		1912		1913		1914	
CARS	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
King	...	...	A	E	A	E	A	B	A	A
Kline Kar	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
Knox	B	A	B	A	B	A	B	A	B	A
Krit	A	A	A	A	A	A	A	A	A	A
Locomobile	Arc	Arc.	Arc.	Arc.	Arc	Arc.	Arc	Arc.	Arc.	Arc.
Lozier	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
Mack	A	E	A	E	E	E	E	E	A	A
Mack, Jr.	...	...	...	...	...	...	...	...	A	Arc.
Marion	A	E	A	E	A	Arc.	A	Arc	...	...
Marmon	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Maxwell (2 cyl.)	E	E	E	E	E	E	...	...	...	...
" (4 cyl.)	E	E	Arc.	Arc	Arc.	Arc.	Arc	Arc.	Arc.	Arc.
" (6 cyl.)	...	...	...	...	...	...	Arc	Arc.	Arc.	Arc.
Mercer	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.

MODEL OF	1910		1911		1912		1913		1914	
CARS	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Mitchell	Arc.	Arc	A	Arc	A	Arc	A	Arc	A	Arc.
Moline	A	E	A	Arc	A	Arc	A	Arc.	..	..
Moline Knight	...	...	...	...	...	...	...	...	A	A
Moon (4 cyl.)	A	E	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc.
Moon (6 cyl.)	...	...	...	...	...	...	...	...	Arc	Arc.
National	A	A	A	A	A	A	A	A	A	A
Oakland	A	E	A	Arc	A	Arc	A	Arc	Arc	Arc.
Oldsmobile	A	E	A	Arc	A	Arc	Arc	Arc	Arc	Arc.
Overland	A	E	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc.
Packard	Arc	Arc	Arc	Arc	Arc.	Arc	Arc	Arc	A	Arc.
Paige Detroit	E	E	A	Arc	A	E	A	E	A	A
Pathfinder	...	...	...	...	...	...	A	Arc	Arc	Arc
Peerless	Arc.	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc.
Pierce Arrow	Arc	Arc.	A	Arc	A	Arc	Arc	Arc	Arc	Arc.
" " Com'l	...	...	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc.
Pope Hartford	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	Arc	A	Arc	A	Arc	A	Arc.	A	Arc
Rambler	A	A	A	Arc	Arc	Arc	Arc	Arc	..	.
Regal	A	E	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc.
Renault	A	Arc.	A	Arc	A	Arc	A	Arc	A	Arc
Reo	A	E	A	Arc.	A	Arc	A	Arc	A	Arc.
S. O. V.	...	...	B	Arc	B	Arc.	B	Arc.	A	Arc.
Selden	A	E	A	E	Arc.	Arc.	Arc.	Arc.	Arc	Arc.
Simplex	Arc	Arc	Arc.	Arc	Arc	Arc	Arc.	Arc.	Arc.	Arc.
Speedwell	Arc	Arc	A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
" "Mead"	...	...	...	...	...	...	A	Arc	B	A
Stearns	Arc	Arc	A	Arc	A	Arc.	...	...	...	...
" "Knight"	...	...	...	...	A	A	A	A	A	A
Stevens Duryea	Arc	Arc.	Arc.	Arc.	Arc.	Arc.	Arc	Arc	Arc.	Arc.
Stoddard-Dayton	Arc	Arc	A	A	A	A	A	A	...	...
" " "Knight"	...	...	...	...	A	A	A	A	...	...
Studebaker	E	E	A	Arc	Arc	Arc	A	Arc	A	Arc.
Stutz	...	...	...	...	A	A	A	A	A	A
Velie 9-45	A	E	A	Arc.	A	Arc.	A	Arc	A	Arc.
Velie 9-50	...	...	...	...	...	...	...	...	Arc	Arc.
Walter	A	E	Arc.	Arc	Arc	Arc	Arc	Arc	Arc.	Arc.
White (Gas)	Arc.	Arc	Arc	Arc	Arc.	Arc.	Arc	Arc.	Arc.	Arc.
Winton	Arc.	Arc.	Arc	Arc.	Arc.	Arc.	Arc.	Arc	Arc.	Arc.

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* * * *

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* * * *

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* * * *

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* * * *

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* * * *

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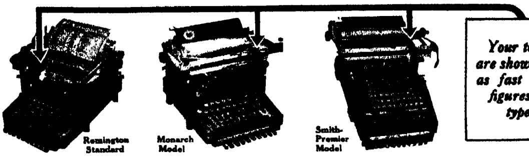

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members of the Whymper party were lost and then strode rapidly forward over the snow and ice to the summit ridge. Warily walking along this narrow causeway they at last reached the topmost point, or rather the highest spot which could be trodden in safety, because, as a matter of fact, the snow had been blown by the north wind over the summit to form a big cornice, a fall through which would have landed one into the valley of Breuil 8,000 feet below

The weather was perfect except for the violent wind The camera was set up, and with the party holding the operator securely, magnificent panoramas from an elevation of 14,705 feet were obtained The work of Burlingham was followed with intense interest through the hotel telescopes, by those in Zermatt below, the arrival of the party at the summit having been awaited with suppressed excitement.

Owing to the time occupied in the ascent, work at the summit had to be hurried, and then, the equipment packed away, the descent commenced. Unfortunately this was more difficult than the upward climb, as the Whymper party encountered its tragedy while going down, while in this instance the presence of the wind which was obliterating the ascending tracks, constituted an additional source of anxiety. Careful haste was urgent as time was slipping by. The first part of the journey was completed without incident, but when the "shoulder" was gained extreme care had to be exercised. The weight of the apparatus now became revealed in a striking manner, for it hampered the free movement of the fatigued porters very appreciably Burlingham, not being familiar with the mountain had one thrill. Descending backward over a projecting rock with a sheer drop of hundreds of feet into the abyss is not an easy acrobatic achievement, and although the operator is an experienced climber, he once got into a serious difficulty He was going down hand over hand, but presently failed to find a finger hold among the crags. He was dangling over a precipice unable to move forward or backward. He called out desperately to one of the porters. The latter, realizing his perilous situation, hurriedly descended hand over hand, keeping the rope taut, and, at last grasping the helpless operator, hauled him up to a point whence descent might be safely effected.

It was six in the evening, and the party were on dangerous ice banks sloping upward at 80 degrees. Snow began to fall, and it seemed as if a blizzard were about to burst. The leading guide apprehensively urged the party to faster movements or they would all be overwhelmed. While descent thereupon was accelerated, no long chances were taken in the bad places, although it was only due to the expert assistance available that no accidents occurred. When at last the club hut was gained it was almost dark, and, as a pall of clouds shrouded the mountain below them they realized that the last pull to the *Cabine* below would be fraught with extreme risk They were too tired to eat the food they had left in the hut in the morning, and without any untoward delay, they continued their downward way over the ragged crags. Presently they caught sight of the lights in the *cabine*, and at 9·15 entered its welcome door, after having been climbing continuously for 18¾ hours. At Zermatt the crowds had grown anxious. The snow-fall on the peak had been observed, and as darkness had overtaken the expedition, became apprehensive of its safety.

When the party, practically played out, entered Zermatt, after having been absent for nearly three days, the guides acknowledged that it was the most difficult enterprise with which they had been associated in connection with the Matterhorn. As for the operator, Frederick Burlingham, he was completely satisfied. He had kinematographed the Matterhorn from Zermatt to its crest upon 1,500 feet of film, which upon subsequent development proved perfect in all its essential qualities, and conveys to the masses some of the finest impressions of the Matterhorn, which ever have been secured. The suc-

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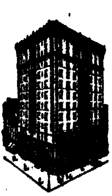

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[illegible] of this expedition prompted Burlingham to repeat his performance upon Mont Blanc, but the highest peak in Europe being easier to climb than the Matterhorn, greater interest is attached to the latter. His movies thereof appeal to mountaineers and are possessed of distinct educational value, while the achievement is one of the most brilliant in the history of kinematography.

The 200 Horse-power Curtiss Motor for the Rodman Wanamaker Transatlantic Flyer

THE 200 horse-power aeronautical motor for the Rodman Wanamaker transatlantic flyer was given a five-hour run at moderate speed recently, and is said to have behaved well. As the motor had had but little limbering under shop power it has been thought advisable to keep the speed below 1,100 revolutions per minute for the first few days, but even at that speed the nine and one half foot experimental propeller shows a static thrust of more than 800 pounds.

The motor is of the Curtiss V-type, eight cylinders, with a bore and stroke of five by seven inches. The cylinders are individual, with welded water jackets of non-corrosive Monel metal. Each cylinder has four tungsten steel valves two and one fourth inches in diameter with seven sixteenths inch lift. All thirty-two valves are operated from a single camshaft. The cylinders are held down to the crankcase by tubular studs from the heads with extension bolts passing through main bearing caps. All the outside bearings are self-lubricated with graphite.

The crankcase is composed of two aluminium castings, thoroughly bridged. The crankshaft is four feet long, two and one fourth inches diameter, and is drilled with an oil duct one and one sixteenth inches diameter. It is made of imported Krupp steel. The connecting rods are I-type forgings with large bearings and oil ducts leading to the piston pins.

Water is circulated by large centrifugal pumps with double outlets. The cylinder heads and valve seats are water cooled, and the exhaust valve stems are water cooled for almost their entire length.

Three rotary gear pumps take care of the lubricating system. One large pump drives the oil under high pressure to every bearing through the main shaft, cam shaft and connecting rods; while two smaller pumps keep the lower half of the case drained. No splash system is employed, the idea being to eliminate the waste of oil and danger of flooding the cylinders should the machine assume an unusual angle.

The gasoline intake manifolds are two and one half inches in diameter and are water jacketed. Ignition at present is by two-spark magneto, but this may be replaced later by two single spark instruments of the half-speed induction type.

The Next Road Congress

THE fourth American Road Congress, and the convention of the American Highway, all its affiliated organizations, and the American Automobile Association, have been scheduled for Atlanta, Ga., during the week beginning November 9th, 1914.

This announcement, which has been awaited by the various organizations working for better roads, was made in Washington by J. E. Pennybacker, secretary of the American Road Congress. The convention city was selected some time ago, but the date was left open until Mr. Pennybacker made definite announcement in Washington.

It was also announced that in addition to the road organizations, committees of the American Bar Association and the American Bankers' Association would work in conjunction with the American Highway Association to make the fourth road congress crystallize the movement for more uniform road laws and a better system of financing road improvement throughout the country.

This will be the first meeting of the American Road Congress in the South, and is a recognition of the great energy and [illegible] that has been made in that sec-

The Spirit of Service

WHEN the land is storm-swept, when trains are stalled and roads are blocked, the telephone trouble-hunter with snow shoes and climbers makes his lonely fight to keep the wire highways open.

These men can be trusted to face hardship and danger, because they realize that snow-bound farms, homes and cities must be kept in touch with the world.

This same spirit of service animates the whole Bell telephone system. The linemen show it when they carry the wires across mountains and wilderness. It is found in the girl at the switch-board who sticks to her post despite fire or flood. It inspires the leaders of the telephone forces, who are finally responsible to the public for good service.

This spirit of service is found in the recent rearrangement of the telephone business to conform with present public policy, without recourse to courts.

The Bell System has grown to be one of the largest corporations in the country, in response to the telephone needs of the public, and must keep up with increasing demands.

However large it may become, this corporation will always be responsive to the needs of the people, because it is animated by the spirit of service. It has shown that men and women, co-operating for a great purpose, may be as good citizens collectively as individually.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES
One Policy *One System* *Universal Service*

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When Was Gen. Juarez President of Mexico?

Our neighbors across the Rio Grande have been monopolizing the front pages of the newspapers for some time now. But with all the publicity they have had, most of us know very little about Mexico.

Except that Cortez was an early settler who fooled the immigration officers by burning his ships, and then gave Montezuma a wallop below the belt when the latter wasn't looking.

Since then Mexico has produced a number of notable figures. We mention Juarez because he was making history down there at the same time that Richmond Straight Cuts were marking off an epoch up here.

The fickleness of popular favor has been proved a thousand times: Richmond Straight Cuts stand as one of the exceptions. The Cigarette that won fame forty-two years ago, still remains the best of all Virginia Cigarettes. It has a quality that cannot be forgotten.

Besides the regular package of 20, these cigarettes are also packed in attractive tin boxes, convenient for den, office or traveling, 50 for 40c; 100 for 75c. These larger packages will be sent prepaid on receipt of price, if your dealer cannot supply them.

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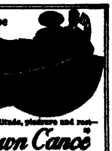

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tion in the movement for improved roads. In 1913, about $40,000,000 was expended by southern States on their public roads, in addition to the labor of thousands of State convicts. Georgia alone had her entire convict force, numbering nearly 5,000, engaged in road construction.

The tremendous importance of guarding against extravagance in road expenditures is shown by the fact that while a recent report of the Census Bureau indicates that the total bonded debt of the forty-eight States last year was $419,157,000, in the single year of 1912 the States spent about $142,000,000 on roads. The total indebtedness had been accumulating for years, and yet in one year an amount equal to about one third was spent on roads. This subject will be dealt with exhaustively at the coming congress

One of the principal results hoped for by the management of the congress will be the establishment of State highway departments in the six southern States which have thus far failed to adopt the plan of State supervision, namely Georgia, South Carolina, Florida, Tennessee, Mississippi, and Texas. Aside from these six States only Indiana and Montana have failed to establish State highway departments for educational or constructive work.

The 1913 American Road Congress was held in Detroit, Mich., with an attendance of about 4,000, representing forty-four States, and with a vast array of exhibits, in which the United States Government, many of the States, educational institutions, and over one hundred manufacturers participated. This year it is expected that the congress will have an attendance well over 5,000, and in preparation for the exposition to be held in connection with the congress, under the direction of Charles P. Light, business manager, the city is preparing to erect temporary structures covering the entire street space on both sides of the auditorium, and to close to traffic, during the entire congress, a viaduct extending two blocks. Steps are now being taken toward securing favorable railroad rates and committees are being formed to provide for the comfort and entertainment of the congress which will include many of the most distinguished men of the nation.

Stresses in Railroad Tracks

A SUB-COMMITTEE has been appointed by the American Society of Civil Engineers to co-operate with a similar committee of the American Railway Engineering Association to conduct tests on stresses in tracks. The members of this committee are as follows:

A. N. Talbot, Chairman; A. S. Baldwin, J. B. Berry, G. H. Bremner, John Brunner, W. J. Burton, Charles S. Churchill, W. C. Cushing, E. Gerber, George W. Kittredge, William McNab, C. J. Ray, F. E. Turneaure, J. E. Willoughby.

The Railway Engineering Association appointed a special committee consisting of the men named in the above and in addition thereto the following:

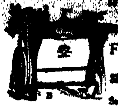
W. M. Dawley, Vice-chairman; H. E. Hale, Dr. P. H. Dudley, J. B. Jenkins, P. M. LaBach.

The first meeting of this committee was held at the Congress Hotel, Chicago, during the annual meeting of the Railway Engineering Association, March 17th to 20th, 1914.

A sum of $10,000 has been subscribed by the U. S. Steel Corporation to defray the expenses of this investigation, and this sum has been supplemented with $2,000 by the American Society of Civil Engineers.

Murder of an American Botanist

A MELANCHOLY postscript must be added to the note published in the SCIENTIFIC AMERICAN of December 13th, 1913, describing the unique expedition to Amboina, Dutch East Indies, undertaken by Dr. Charles Budd Robinson of the Philippine Bureau of Science. Press dispatches report that the explorer was murdered by natives soon after his arrival in the island. Dr. Robinson was a Canadian by birth, but was partly educated in the United States, and was at one time on the staff of the New York Botanical Garden.



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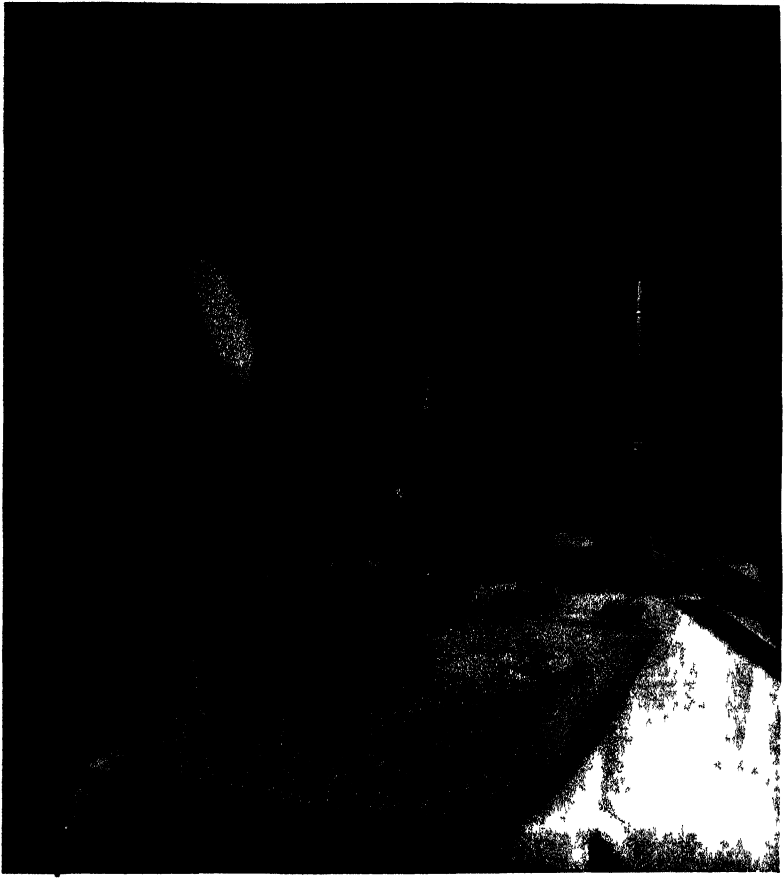

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Vol. CX. No. 13
March 28, 1914

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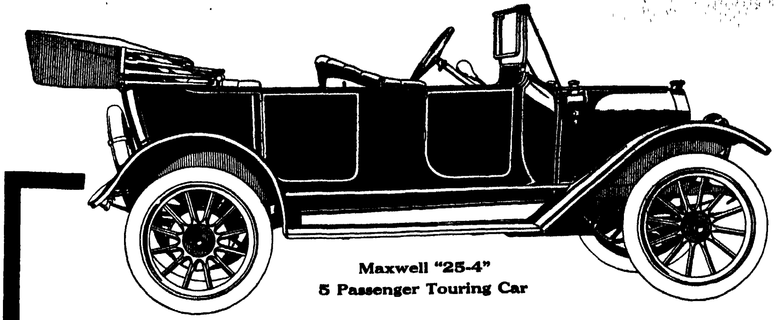

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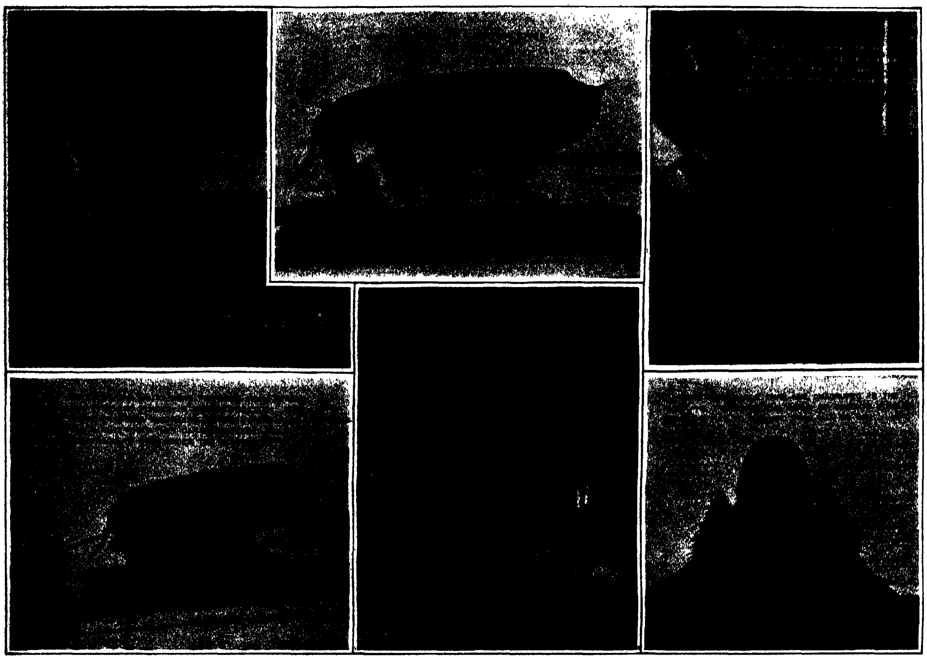

How the American Museum giant model of a flea was made.

A Huge Model of the Flea

NOT the least striking and instructive of the thousands of exhibits in the American Museum of Natural History are the large models of common insects, which have attracted the wondering attention of thousands. Is the mosquito really so fierce an animal? Is the fly so horrible? Who made these models? How did he do it? Probably every one of the visitors to the American Museum of Natural History who has seen these wonderful models has asked himself these questions. Not one in ten thousand realizes that the models are works of art in their own particular way, and that in the whole world there are probably not more than two or three artists who are sufficiently skilled in entomology, and whose hands are sufficiently trained and dexterous to produce this work. The American Museum of Natural History is fortunate in having secured in Mr. Ignaz Matausch one of these very few and highly exceptional scientific artists to prepare its models. It may be safely said that Mr. Matausch is probably the only man on this side of the Atlantic Ocean capable of executing such work.

Mr. Matausch's latest creation is a flea magnified in wax 1,728,000 times the size of the insect in bulk. In other words, 1,728,000 actual fleas could be packed into his model if it were hollow. Although the model excites admiration because of the skillful manner in which it was prepared, it tells nothing of the painstaking preliminary studies which were necessary before work could be commenced.

Strange as it may seem, no picture has ever been made of the living flea. The insect as it is pictured in text books is a dead insect. To the uninformed it seems a very trivial matter whether a flea is magnified in wax alive or dead The entomologist knows better He knows that the segments telescope after death because of the shrinkage of the internal organs.

Accordingly Mr. Matausch began by making an entirely new external anatomical study of the flea Numerous specimens of the insect were observed under the microscope, so far as possible in the living condition When all that could be learned had been thus acquired and drawings had been carefully made to scale, the appendages were separated from the body. While even the dissection of the larger members is a test for any skilled hand, what shall be said of bristles and hairs so minute that the point of the finest dissecting needle is enormously larger than the part to be separated? The task is not unlike that of severing a human hair from the scalp with the aid of a crowbar Literally, dozens of drawings had to be made to scale; each part had to be minutely measured.

After all this painstaking preliminary work models of each part were prepared of the desired size in modeling clay and forms made in plaster of Paris. From these plaster forms hollow models of the parts were made in a properly colored wax composition. The hollows in the wax parts served for the wires in the legs and other supports and connections which give stability to the whole. The finishing of the details of the structure then followed. Bristles and hairs were prepared from German silver wire and placed at the points revealed in the drawings by microscopic study. The whole model was thereupon colored, assembled and treated with a coat of lacquer to preserve it.

Those who look at this flea in the American Museum of Natural History will see far more than even the eye of a trained entomologist sees with the aid of a powerful microscope. So small were some of the hairs (for example, the two that project upward from the mouth parts of the insects) that days of patient observation were required before at last their point of attachment could be seen in a particularly favorable moment.

Perhaps that organ of the enlarged insect which will attract most attention is the biting mechanism As pointed out by Carroll Fox in a bulletin of the United States Public Health Service on "The Rat and Its Relation to the Public Health," the flea does his biting with a beak which consists of three inner and two outer parts The middle one of the inner parts terminates in a piercing point; the others in saw-like endings. They are close together and constitute the salivary and sucking ducts, through which the saliva is forced into the wound and blood extracted The two outer parts form a protecting case at rest and are not inserted, but serve as a guide, doubling back in the act of biting. They probably assist the piercing parts from the wounds In front of the beak are two plate-like members, ending in a sharp edge; after the piercing parts are inserted deep enough, they help in enlarging the wound.

It is with this beak that the flea sucks up blood. When the bubonic plague infection prevails, it is the bite of the flea that transmits the germs from rat to man, and from man to man.

For Shingles Alone, 750 million feet of timber is cut in that part of the State of Washington which lies west of the Cascades.

SCIENTIFIC AMERICAN

Founded 1845

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention Accepted articles will be paid for at regular space rates

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Lesson of a Ferryboat Collision

THE recent collision in the North River between a Lackawanna Railroad ferryboat and a freight-car float, which occurred in broad daylight, draws attention to a danger in ferryboat navigation on this waterway, which only needed such an accident as this to show how disastrous its results may be. We refer to the practice, altogether too common, of navigating two ferryboats which are steaming in the same direction, with the second boat in close proximity to the one ahead The danger lies in the fact that the leading boat obstructs the view of the pilot of the second boat to such an extent that, when the leading boat changes course, the following boat may suddenly find herself in close proximity to a craft which was shut out from view by the boat ahead. In the accident referred to, the "Ithaca" of the Lackawanna Line left her dock at the foot of Barclay Street at about the same moment as the Erie ferryboat "Goshen" left her berth at the foot of Chambers Street. The "Ithaca" was steaming on the port quarter of the "Goshen," and so close that a biscuit could be tossed from one boat to the other. Then, upon the "Goshen" turning to port and clearing the bow of the "Ithaca," the latter boat found herself only a few hundred feet from a Jersey Central float laden with ten freight cars. There was no room to maneuver, and the float crashed into the ferryboat, crushing and killing three of the people in the cabin. Those who make constant use of the ferryboats in the North and East Rivers will understand from the above how this accident happened, for they will have often noticed that one boat will follow another in such close proximity that its view ahead is very much obscured, particularly as regards the observing of such low-lying craft as a float or tugboat. The danger is so real that we think it would be advisable to pass a law requiring ferryboats to reduce speed, when in close proximity to a boat ahead, sufficiently to enable them to be maneuvered in any sudden emergency that may arise

Stresses in Railroad Tracks

WE are greatly interested to note that a sub-committee has been appointed by the American Society of Civil Engineers to co-operate with a similar committee of the American Railway Engineering Association to conduct tests on stresses in railroad tracks A sum of $10,000 has been subscribed by the United States Steel Corporation to pay the expenses of this investigation, and we understand that this sum has been supplemented with $2,000 by the American Society of Civil Engineers Doubtless, as the importance of this investigation is realized, other contributions will be forthcoming, and a sufficient sum will be available to render this investigation as comprehensive and searching as it must be to secure adequate results

So far as we know, except for limited experimental work done by individual engineers, there has been no attempt to determine with scientific accuracy the amount and kind of stresses to which modern railroad track, including every element from the grade line through the ballast, ties, and rail, is exposed by the action of moving trains Considering that the track lies at the foundation of successful railroad transportation it is surprising that it was not subjected periodically to careful and exhaustive physical tests, to determine the nature and extent of the stresses to which every part of it is subjected under the various conditions which exist both in track and traffic. These things are known, of course, in a general way. It is understood, for instance, that a soft, yielding spot in the subgrade will cause the rail to be subjected to bending stresses far greater than those which occur under normal conditions. We know that the same results will follow if two or three adjoining ties are badly tamped while those beyond them on either side are fully tamped. We know that during the frost of the late winter, the heat of the rays of the sun, especially under certain atmospheric conditions, may soften the roadbed where the sun strikes full upon it, leaving the adjoining stretch of track, which may be under the shadow of a bridge or a building, in a thoroughly frozen condition—a situation which, as in the case of the accident on the New York Central at Woodlawn several years ago, no doubt greatly contributes to derailments But the engineer would like to know how great and how sudden may be the change in track conditions due to such juxtaposition of sunlight and shadow.

These questions and many others will now be determined by this Committee, which doubtless will take up the subject of tie plates, screw spikes, track spikes, the best form of rail-joint fastenings and many another subject upon which, even at this late hour, much valuable light is needed. The Safety First movement is very much to the front in these days, and we do not know of any contribution to safety which can exceed in importance the work of this committee, the list of whose membership was given in our last issue.

The Ship and Its Lifeboats

THE International Conference on Safety of Life at Sea, whose meetings extended from November 12th, 1913, to January 20th of this year, has published a convention embodying the results of its deliberations, which will be ratified on the last day of this year, and will come into force on July 1st, 1915. We hope to give an early and more extended reference to this convention; but for the present we direct attention to the more important sections, dealing first with the construction of ships and second with the provision of lifeboats. Broadly speaking, it must be admitted that the work of the conference, representing as it does the conscientious and earnest labor of some of the ablest and most experienced minds connected with the construction, control and operation of ships, is certain to exercise a decided influence on the future design and operation of steamships

The conference dealt through its five sub-committees with the following subjects: Safety of Navigation, Safety of Construction, Wireless Telegraphy, Life-saving Appliances, and Certificates. As was to be expected, the various sub-committees found no difficulty in reaching practically unanimous conclusions on the questions of Safety of Navigation, Wireless Telegraphy, and Certificates The greatest division of opinion developed in the sub-committee on Safety of Construction and to a less degree in that on Life-saving Appliances; and it is to these two subjects, which to our mind are strictly interdependent, that we confine ourselves in the present discussion.

It developed during the inquiry into the "Titanic" disaster, held under Lord Mersey, that in the years preceding that disaster, the question had been raised and rather fully debated, as to whether the number of lifeboats which a passenger ship was required to carry should not have a certain, definite relation to the degree of safety against sinking which had been secured in the construction of the ship itself The "Titanic," which failed so completely in the hour of extreme trial, both as regards the unsinkable qualities of the ship itself and as regards the provision of lifeboats, had been built, as was shown at the time, in strict conformity to the requirements of the Board of Trade. The Board of Trade rules demanded that the spacing and height of the bulkheads of the "Titanic" should be such that she could fill two adjoining compartments without sinking below a draft that would bring the water level within a foot or two of her bulkhead deck. They required, also, that she should provide lifeboat accommodation for about one third of those on board. Both of these conditions were fulfilled The "Titanic," however, was so badly ruptured that at least five of her compartments were opened to the sea—and she went down; furthermore, the boats available carried only about a thousand passengers, and over fifteen hundred of her complement were lost with the ship.

The rules adopted by the London Convention require that the height and spacing of the bulkheads shall be such that three of the largest compartments of a passenger ship of the type of the "Titanic" may be filled without endangering the ship, and there are other provisions as to height of bulkheads and the watertightness of the bulkhead decks, which if ratified and followed, will produce a much safer ship than those built under the existing laws. Whether the sub-committee on construction has gone far enough in the direction of safety is a question open to debate; we are inclined to think that it might have made its rules more stringent without imposing any serious burden of cost upon the shipping companies.

The recommendations of the sub-committee on Life-saving Appliances are so sweeping that we cannot help but feel that the committee was unduly influenced by popular clamor and by the well-meant, but ill-digested opinions of the popular press. This committee calls for the provision of lifeboats for every soul on board; and this, in the case of the largest trans-Atlantic liners, 900 to 950 feet in length, means that their top decks must be lumbered up with a mass of lifeboats so large that in the event of emergency it is improbable that, even under favorable conditions, they could all be safely loaded and got away from a sinking ship.

There is no doubt that this provision was influenced largely by recognition of the fact that, however perfect the sub-division of a big ship may be, there will always be the possibility that a serious fire will necessitate everybody on board taking to the boats. As against this view, it should be noted that the Committee on Construction calls for the provision of fireproof walls, or bulkheads, running across the passenger accommodations at stated intervals, which must be capable of confining a fire to that section in which it originates. If this provision is adequately carried out, we believe that the occurrence of a conflagration that would drive everyone to the boats would be a very remote contingency. To sum up, we consider that it is entirely within the resources and skill of the ship designer and ship builder to produce a ship which shall be at once practically unsinkable and practically fireproof. If this be true, such a ship need carry only a limited number of boats, sufficient, let us say, for the ordinary uses of docking, and for assisting in the transfer of passengers to the rescuing ships which have been called to the vicinity by wireless.

The SCIENTIFIC AMERICAN, from the very day of the "Titanic" catastrophe, has laid down the principle that the proper method of safeguarding the lives of passengers at sea is to make every ship so far unsinkable, that, in the event of serious disaster, it will act as its own lifeboat, and take care of its passengers until they can be either brought into port or transferred at sea to other ships. The mere logic of the thing teaches us that the only safe and thoroughly reliable lifeboat is the ship itself. Can it be denied that the mass of small craft, open boats, motor boats, life rafts and what not, that encumber the top deck of an Atlantic liner are, in a sense, a confession of failure—an admission on the part of the architect and ship owner that although they have succeeded in making the ship big, fast and luxurious, they have not succeeded in making her safe? We note that our contemporary, the *Engineer* of London, is now taking this sensible view of the case. "Boats," it says, "are a continual rebuke to the shipbuilder and the ship commander; for they remind him that his skill is still so far wanting that his vessel is still liable to accident on the high sea It must be the object of both men to remove that rebuke."

However, the London Conference calls for boats for all. We understand that one of the big 900-foot ships that will make her maiden trip to New York during the coming summer will enter port with no less than ninety-two lifeboats crowded upon its top deck. Well, if it must be so, we can only express the hope that the gradual appreciation of the fact that a big ship can be made practically unsinkable, will lead to the reduction of this unnecessary top hamper, and that ultimately a few large and well found motor boats will take their place.

Delta Rays

THE name δ ray was given by J. J. Thomson in 1905 to the slow electrons emitted by polonium and which has previously masked the positive charge of the α rays. A little after Rutherford discovered a similar emission for radium and showed that it is not exclusive to the source of the α rays, but is produced by all bodies struck by these rays.

Recently Gargan and Bumstead have shown that certain rays of a sheaf of δ rays are endowed with greater velocities than those which have hitherto been measured; a retarding potential difference of 1,700 volts does not stop them. In a recent memoir Bumstead arrives at the following results. When α rays strike a metal they cause the emission of electrons of which the velocities vary progressively from a very low figure to about three thousand million centimeters per second. He proposes to call all these δ rays. At the same time there is an emission of positive ions from a metal placed in a high vacuum and bombarded by α rays: these ions seem to come from gas absorbed into the surface of the metal.

When the δ rays encounter a solid, they produce an emission of slow electrons which Bumstead calls tertiary electrons. Their number is much greater than that of the δ rays which produce them.

Engineering

The First Railroad in Iceland.—According to a dispatch from Copenhagen, a railroad 60 miles in length is to be built in Iceland. At present there is not a mile of railroad in the whole of that island; indeed, it is devoid even of good roads, as we understand the term in this country. Such roads as exist in the island are mere bridle paths.

Wood Spring Tires.—An interesting experiment has been made in England with wood spring tires which have been fitted to a one-ton motor truck. The experiment has been satisfactory as far as it has gone, as the wood blocks do not appear to have been deformed and show little signs of wear. *The Engineer* states that these results were obtained after a run of over 3,000 miles.

The Coal Fields of the Antarctic.—Prof. Edgeworth Davis, lecturing before the Royal Geographical Society, stated that he did not believe the world as yet realized the scientific as well as the commercial importance of the great coal fields which Sir Ernest Shackleton discovered at the head of the Beardmore Glacier, and which in a small strip contain probably as much coal as exists in all the unworked coal fields of Great Britain.

Tunnels Versus Bridges.—The idea that a tunnel can be compared favorably with a bridge, in point of its capacity for a given cost, is erroneous and unfortunately is very widespread. A bridge such as that proposed across the North River would accommodate six to eight times as much traffic as could be sent through a tunnel; in other words, the cost for a given amount of traffic would be very much greater for the tunnel than for the bridge.

The Father of the Dreadnought.—To the lately deceased Cuniberti, Major-General of the Italian Naval Engineering Staff, is due the credit of having first suggested the modern dreadnought. It was he, also, who suggested the modern type of scout, and he was one of the first to study the question of the application of liquid fuel to marine boilers. It was his influence which led to the adoption of this fuel in the Italian torpedo boat service.

Gatun Lock as a Dry Dock.—One of the locks of the Panama Canal at Gatun has been put to the novel use of serving as a dry dock for the overhauling of five of the submarines, T-1 to T-5, which have been stationed at the Atlantic entrance to the canal since December 12th last. The lock chambers are arranged in pairs, and it is therefore possible to use one of them as a dry dock without interfering with the passage of vessels through the other.

Panama Grows More Healthy.—The last report of the Department of Sanitation at Panama for the year 1913 shows that for the Isthmian Canal Commission and the Panama Railroad Company, out of 56,054 employees there were 473 deaths, giving a rate per 1,000 of 8.35. This is the lowest rate recorded since the United States took possession of the Canal Zone. The next lowest was in the previous year, 1912, when the rate per 1,000 was 9.18. The highest, 41.73, occurred in the year 1906.

A Transformed Tank Ship.—A sailing tank ship, "Jules Henri" of Marseilles, has recently been transformed into a motor tank ship at Wilton's shipyards in Rotterdam The ship, which originally was 76 meters long, was cut in half after the masts had been removed, and a new section 17 meters long was built at the break. Two Diesel motors each of 500 horse-power were then installed. The transformed motor tank ship is now 93 meters long by 12.25 meters wide, and has a capacity of 3,000 tons of oil. After a first voyage to the Black Sea the ship will be employed regularly between Europe and America.

Two of the Most Recent Types of Oerlikon Steam Turbines are now running in the central electric station of Stockholm, these being of 10,000 horse-power size. Turbine and dynamo make up a compact group, and the turbines are of a new design, which is claimed to have a number of advantages, one of these being a low steam consumption of 7.9 pounds per horse-power hour. The turbines operate at 3,000 r.p.m. standard speed. Such turbines are made up as usual of blade wheels each in a separate steam chamber, but the combination of speeds and pressures within the turbine is based on a somewhat novel theoretical design.

Concrete Poles Withstood the Storm.—The great strength of reinforced concrete telegraph poles was proved to a demonstration during the violent storms of this winter. The Pennsylvania Railroad Company states that this was shown in the case of their telegraph lines, where a large number of reinforced concrete poles were exposed to the recent heavy storm, which practically isolated New York city. Though many of the wooden poles were broken down by the wind, in no case did a reinforced concrete pole fall, and this in spite of the fact that so severe was the stress that the wooden cross arms upon some of these poles were broken. They are made of Portland cement, reinforced with steel rods. They have the further advantages, in addition to their strength, that they do not rot at the ground, and that they never rust as do the steel poles.

Electricity

Marconi's Radiotelephone Experiments.—According to press dispatches, Mr. William Marconi is meeting with considerable success in his wireless telephone experiments, and is confident that transatlantic radiotelephony will be an accomplished fact at some not far distant day. Mr. Marconi has been conducting experiments from the Duke of Abruzzi's flagship, the "Regina Elena," off Agosta, Sicily, and has succeeded in maintaining radiotelephonic communication with ships from 18 to 43 miles distant. In connection with his receivers Mr. Marconi has been using phonographic recorders and has succeeded in recording telegraph signals from Clifden, nearly 2,000 miles distant, and from Canada, 4,000 miles away.

Copper Wire can now be made by an electric bath process, which is said to be very successful. A fine copper wire is connected to one pole of a battery, and is made to traverse a bath of sulphate of copper such as is ordinarily used for electro-plating, with a small amount of sulphuric acid added. In the bath is placed a heavy copper plate as the second electrode. The fine wire acts as a core and is covered with the deposited copper. Then after passing through a washing tank it is dried and runs upon a reel on which it is hardened by means of friction. The wire then returns to the plating bath and takes another layer, and so on until it has attained the required thickness. It is advisable to have the plating done by degrees and not all at once, as the metal has a better quality.

Effect of Parallel Condensers on Receiving Antennæ.—In a paper on "The Effect of a Parallel Condenser on the Receiving Antenna," read by L. W. Austin at the March meeting of the Institute of Radio Engineers, it was brought out that the practice of using a variable condenser in parallel with all or part of the inductance in the receiving antenna to receive longer waves is convenient inasmuch as it does away with the necessity of small inductance steps and reduces the total amount of inductance required but is usually found to be less efficient than pure inductive tuning. Tables showing the effects of different values of parallel capacity for two sizes of artificial antenna were shown. The readings were made with a galvanometer replacing the telephone. As the capacity was increased and the inductance decreased, the galvanometer deflection decreased. Replacing one half the inductance by capacity decreased the deflection about one third. Practically the same results were obtained with the real antenna.

The Number of Licensed Wireless Stations.—The annual report of the Bureau of Navigation, Radio Division, for the fiscal year ended June 30th, 1913, showed the following.

Class. Radio Station Licenses Issued.	Number.
Commercial, ship	145
Commercial, land	22
Special, land	17
Amateur	1,312
Total	1,496

Grade. Radio Operator Licenses Issued	Number.
Commercial, 1st	1,617
Commercial, 2nd	315
Experiment and instruction	8
Cargo	1
Amateur, 1st	1,075
Amateur, 2nd	766
Total	3,782

Records	
Total number of inspection records filed	3,916

Since then, up to January 10th, 1914, 465 commercial radio operators' licenses and 679 amateur radio operators' licenses were issued.

Stimulating Plant Growth With X-rays.—Experiments made by Dr. Schwartz, a German scientist, show that X-rays stimulate the growth of plants and of living tissue in general, but in order to produce good results it is required to adjust the value of the rays in order to prevent a destructive action such as can also take place without due care in making use of them. Should the exposure to the rays be too long, the effect can exceed the proper limits and become dangerous. Working upon plants, he finds that an under-exposure of 30 seconds has no appreciable effect of any kind upon the growth, and, on the contrary, a long exposure of 5 minutes is seen to alter the tissues and hinder the growth of the plant. The proper time appeared to be 150 seconds, and shortly after exposure to the rays the plants were so much stimulated that in three weeks' time they had grown to double the height of the other specimens. Such experiments were made with the use of young sprouts, and not upon plants in an advanced state of growth. As to the effect on the tissues of the human body, he finds that in the case of wounds where there is a decrease in vitality of structures, this is stimulated to quite a degree, so that, for instance, an obstinate wound will heal up after a few *séances*. It is well known that the X-rays will produce severe burns upon the skin, but this is caused by a too strong action.

Science

Killing of Two Explorers.—The Bulletin of the American Geographical Society states that there is no longer any reason to doubt the report that the explorers Harry V. Radford, of New York, and T. G. Street, of Ottawa, were killed by Eskimos at Bathurst Inlet on or about June 5th, 1912, as the result of a quarrel.

A New Estimate of the World's Radium Supply.—How large is the quantity of radium salts existing at the present time? At a lecture recently given in France, Besson placed the amount at about seven grammes. The price of a gramme of hydrated bromide of radium is about $80,000 more or less, which means that a gramme of pure metallic radium must be worth about $156,000, or in other words about $78,000,000 a pound.

A Fatigue Museum.—Mr. Frank B Gilbreth, the well-known efficiency engineer, has started a museum of devices for eliminating fatigue in industry The museum is in Providence, R. I. Among the exhibits to be found in the museum are factory stools and chairs of many kinds adapted to many lines of work for both men and women employees Ultimately the museum will contain a permanent exhibit of all kinds of factory devices that affect the physical well-being of the worker. It is not limited to machine safeguards or sanitary arrangements.

The Turco-Persian Boundary has heretofore been one of the problematical features on the map of Asia. As far back as 1843, a mixed commission attempted to define this frontier with only partial success, and since that time repeated efforts have been made by the great powers, as well as the two countries immediately concerned, to complete the task, but the boundary has remained rather a zone of debatable territory than a definite line Finally, in November of last year, a complete understanding on the subject was reached, and a protocol was signed in Constantinople in accordance with which a commission consisting of British, Russian, Turkish and Persian delegates will undertake a survey of the boundary This is expected to require at least 18 months, and will doubtless be productive of interesting geographical results.

The Lowest Temperature Recorded in the Atmosphere.—The "record" low temperature registered in a sounding-balloon ascent is reported from Batavia, where on November 5th, 1913, the remarkable minimum of 91 9 deg. below zero Cent. (—133.4 deg. Fahr.) was found at an altitude unfortunately unknown, as the clock-work stopped during the ascent, but supposed to be about 17 kilometers (10.6 miles). On December 4th, an almost equally low minimum was registered; viz., —90.9 deg. Cent (—131.6 deg Fahr), at an altitude of 16.5 kilometers (10 2 miles). In this case, the apparatus worked satisfactorily and recorded an extraordinary rise of temperature between the above-stated minimum at 16.5 kilometers and a reading of —57.1 deg. Cent. at 26,040 meters (16 2 miles); i. e., a total rise after entering the stratosphere of 33.8 Cent. or 60.8 Fahr. degrees. On August 6th, 1913, a balloon sent up at the same place showed a rise of 18.9 Cent. (34.0 Fahr.) degrees after passing the altitude of minimum temperature. In this case, the balloon rose to 22 kilometers (13.7 miles). These observations show that the name "isothermal layer," applied to the stratosphere, is sometimes a misnomer

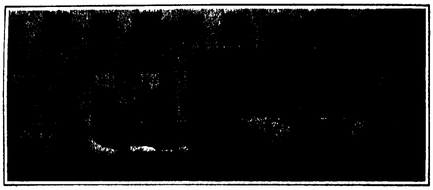
A Comedy in Antarctic Nomenclature.—Apropos of the editorial "Mawson and Wilkes," published in our issue of March 14th, it appears that American geographers have been over-sanguine in assuming that the name "Wilkes Land" was at last indelibly inscribed on Antarctic maps As pointed out in our editorial, a British chart of 1856 shows this name in its proper place. For the past half-century, however, the backings and fillings of British cartographers concerning the name and its application have furnished diversion to Americans endowed with a sense of humor, and have been taken *au grand serieux* by others. The latest episode in the comedy (as we prefer to consider it) takes the form of a map published in our English contemporary *Nature* of March 5th, page 12. Here we find "Wilkes Land" printed where it belongs, but in type which conveys an unmistakable impression of evanescence, while immediately beneath it, spread over the same tract of land, appears in large, bold letters the name "King George V. Land." The latter name is a little over a year old, having occurred for the first time in a wireless message of February, 1913, from Dr. Mawson, who was then in Adelie Land. We believe, however, that Mawson had no intention of giving this name anything like the geographical extension indicated by the chart in *Nature*. A definite statement from him on this subject will be awaited with interest, though it can in no wise affect the validity of the earlier name. For American geographers, at least, the long stretch of the Antarctic between Victoria Land and Kaiser Wilhelm Land will remain "Wilkes Land" until the time—now, perhaps, measurably near at hand—when this portion of the Antarctic is annexed by the Commonwealth of Australia Then, of course, we shall have to accept whatever name the Australian authorities choose to assign to it.

Motor Vehicles on Runners

ALTHOUGH it is possible with little snow on the ground to run a motor cycle with its rubber tires, it has been found impossible to do so when the fall measures several inches. A resident of Galt, Ontario, has solved the problem as shown in one of our photographs. The rubber tires were taken off the front wheel of the machine, and off the wheel on the side car, which is attached to the machine, and runners were bolted to the rims of the wheels. The rubber tire remains on the rear wheel of the machine for driving purposes, but the runner on the front wheel makes the rut, thus permitting the use of the one tire. The motor cycle has been given a thorough test, going through a foot of snow without any trouble at all.

The same idea applied to commercial use is pictured in the second photograph, which shows a three-wheeled tractor hauling a truck through the snow. Obviously, only the drive wheels need contact with the ground. The other wheels make work by crushing through the snow, and if supported on runners materially reduce the work of the motor. The runners may be applied or removed very readily. This is a good suggestion for motor truck owners to jot down for use next winter.

Motor cycle and side car mounted on runners.



Eliminating unnecessary work by the use of sled runners.

Lifeboat Test Off Sandy Hook

NEVER, probably, has greater interest been aroused in the question of lifeboat construction than at the present time. This is natural; for the loss of the "Titanic" is not so far removed, but its lessons are still foremost in the minds of shipbuilders and shipowners; and the past winter, with its unusually boisterous weather and its exceedingly long list of wrecks at sea, in which the lifeboat has been called into constant requisition, has concentrated attention on these small craft as never before. Indeed, next to the subject of hull construction, the matter of lifeboats and their stowage was the most important that came up before the London Conference on Safety at Sea.

We present illustrations of a new type of steel lifeboat which, on two successive days last week, was subjected to severe tests in the presence of Gen. Uhler and the Board of Supervising Inspectors of Washington, D. C.

The lifeboats were designed by Capt. Lundin, and they embody the result of many years of practical experience and observation. It will be seen that they are a wide departure from what might be called the whaleboat type of lifeboat, with which we are all familiar. The craft embodies the stability and great carrying capacity of the raft with the maneuvering qualities of the standard type of boat. This was shown in a series of tests off Sandy Hook on the second day, when a 24-foot boat, heavily laden and propelled by six oars, showed a surprising turn of speed and excellent maneuvering abilities. The boats are built of galvanized sheet iron, and they consist of a decked hull with sides extending about 15 inches from the deck, and provided with weatherboards which automatically lock themselves in the upright position on being raised. When folded down, they form a firm platform to rest the second boat on, no other chocks being necessary for the top boat. An excellent feature is the provision along each side of a very thick continuous fender of balsa wood, which is flat on its inner side, where it lies against the hull, and is molded on its outside to conform with the generally rounded scow lines of the lifeboat. Balsa wood is about 40 per cent lighter than cork, and the fenders alone would assist materially in keeping the boat afloat.

The Lundin boat is of true lifeboat construction with an outer and inner floor, both of steel. The bottom is divided into numerous watertight compartments, each of which is provided with a manhole and watertight manhole cover. The inner floor, or deck, even when the boat is loaded with sixty or more persons, is well above the waterline, and each compartment is provided with drain pipes for self-clearing, equipped with floatable ball valves of a long tried pattern, which prevent the water from squattering up from below. The space provided for passengers is, therefore, self-bailing, and any spray or water that may enter the boat quickly drains away.

In the test on Saturday three boats were put through their exercises; one, a 24-foot metal boat with the Lundin features, of the general ship's boat model, but of very full body and provided with balsa-wood fenders; another, a 28-foot Lundin boat of the scow type, with double bottom; and the third, most interesting of all, was a large 30-foot power-propelled boat, provided with a large watertight steel cabin, driven by a 24 horse-power Standard motor, and equipped with a wireless outfit capable of sending messages for seventy-five miles. The power lifeboat can make six or seven miles, under power, and in the case of shipwreck is capable of taking eight or ten other boats in tow and holding them together, head to sea, and by means of its wireless, bringing up the rescuing ship. The superstructure of the closed cabin is generally semi-circular in cross section, with bulkheads closing in the forward and after ends. In each bulkhead are two large steel doors which are closed against rubber gaskets. The cabin can hold sixty or more people, and ventilation is provided by a series of hinged portholes ranged along the sides. The lower part of these portholes forms a rowlock, and the opening is just large enough to permit free movement of the oars.

The weight of the double bottom and the circular form of the cabin combine to give to these boats absolute self-righting qualities. This was proved in a test which is herewith illustrated, in which the boat was rolled over, by means of a crane, until it was bottom upward, and then released. Within two or three seconds' time it had righted, the heavy weight of the double bottom, combined with the form of the cabin, making this result inevitable. Capt. Lundin believes that a boat of this kind, even if filled with passengers, might be entirely rolled over by a breaking sea, without endangering the lives of the passengers.

The experience already had with steel lifeboats proves that they are able to go through a degree of rough usage without springing a leak that would completely disable any wooden lifeboats.

The difficulty experienced in endeavoring to launch the lifeboats of the "Volturno," shows that the wooden lifeboat is doomed, should it be swung while it is being lowered against the side of a rolling ship, or should it, when in the water, be swept against the hull of the vessel. The wood in such a case splinters badly and heavy leaks are developed. The steel lifeboat, on the other hand, has shown that it can suffer a surprising amount of distortion and come through the ordeal watertight. One of our illustrations shows a standard metallic lifeboat on an American coast liner which

(*Concluded on page 272.*)

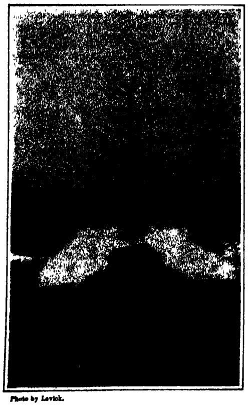
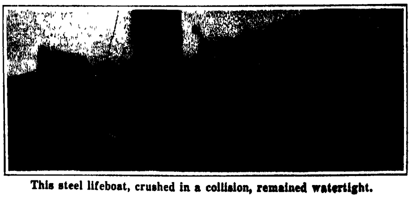
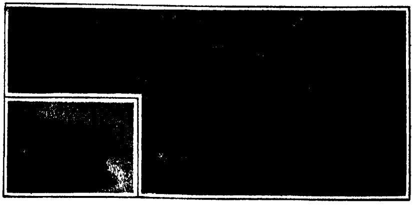


Photo by Levick.

Power lifeboat towed at 13 knots in rough water.



This steel lifeboat, crushed in a collision, remained watertight.



Stability test of Lundin power lifeboat with ten people on the rail. The insert shows the boat capsized but afloat.

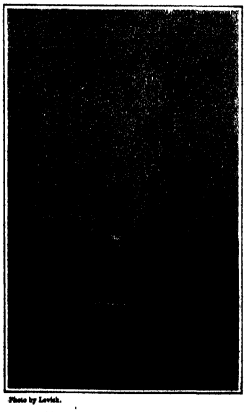
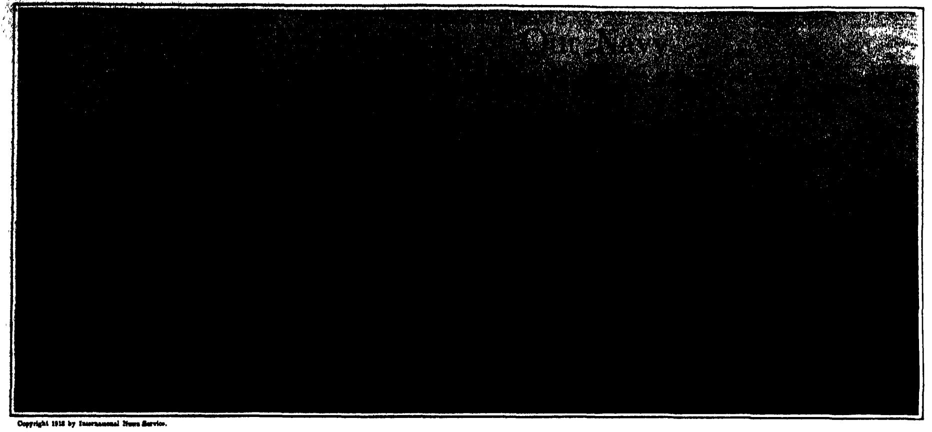


Photo by Levick.

Note the high bow, steel cabin and wireless outfit.



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THUS far in our study of the problem of our Navy we have shown:

First, that the necessity for the creation and maintenance of a navy of the first class has been imposed upon the United States by circumstances over which this country had no control. We have seen that, although it was the dream of the Fathers of this republic to found a new nation, which, free from any entangling foreign alliances, should exemplify and perpetuate within its own borders those principles of liberty and equality which had been written into its Constitution, the day ultimately arrived—as it was bound to do—when a resistless destiny thrust this country out into that broad arena of world politics, wherein is being carried on an eternal and inevitable struggle for international pre-eminence. And it was shown, further, that by forbidding the partitioning of China, and by building and fortifying the Panama Canal we have rendered this country the very storm center of that greater struggle for commercial and naval pre-eminence, which the opening of this waterway and the development of the Orient is certain to produce.

Second, we have seen that, although our Government at first responded nobly to the call for a greater navy, and thereby showed its recognition of the fact that the day of our isolation was over, and that we must henceforth accept the burdens and exercise the functions of a great world power—of late years we have been guilty of the inexcusable folly of neglecting our Navy, and this at the very time when we were affirming our world policies with a definiteness and daring for which modern history presents no parallel. It was shown that we have curtailed our naval construction during the years when the nations that would be most likely to challenge our policies were accelerating their own naval construction; with the result that, in the event of dispute, we may have to accept the alternative of an ignoble abandonment of our policies or a crushing defeat upon the high seas.

Third, we have shown that the highly technical and specialized nature of the modern instruments of war has largely obliterated the advantage of certain mental and physical characteristics, in which our people have been pre-eminent; with the result that the issue of future wars will depend more than ever upon the possession of a preponderance of the mere materials of war—that victory in the great day of trial will lie with the fleet which can concentrate the greatest number of heavy guns in a given length of battle line. We proved, furthermore, from the past history of our country that, although the cost of a fleet of fighting ships is enormous, it is positively insignificant in comparison with the cost of unpreparedness, as shown by the fact that policies of retrenchment—that is to say, peace policies that were provocative of war—have saddled this country with an annual pension roll of $180,000,000.

Now since war, with its irreparable loss in life and treasure and its crushing legacy of an enormous annual pension roll, is the greatest physical calamity that can fall upon the country, simple common sense demands that, if any means can be found to prevent war—to insure against its losses—they shall at once be adopted.

Geographically, the United States is so situated that there is only one direction from which a first-class foreign power could wage war with any hope of success, and that is from over sea. Furthermore, no power would dream of sending its fleet over sea unless it could meet us with such a preponderance of force as to render victory certain.

The possession by the United States of a powerful and well-balanced navy, fully equipped and manned, in constant training, and with a reserve of ships and men capable of swift mobilization, would be an absolute insurance against war—IF, AND ONLY SO LONG AS, THAT NAVY WAS MAINTAINED AT A CERTAIN STANDARD OF STRENGTH WITH REGARD TO ITS POSSIBLE OPPONENTS.

"Its possible opponents;" and who are they? England? No; for we could not hope to match her enormous navy; nor is it necessary. Not only do the international interests of that country broadly coincide with our own (the Monroe Doctrine, for instance, was proclaimed with her approval and still receives her moral support), but both the British government and its people are distinctly friendly in their attitude to the United States In witness whereof, take note of her patience in the matter of the Panama tolls, and her admirable self control and tact in the delicate situation brought about in Mexico by the killing of one of her subjects—a kind of international episode in which it has ever been her policy to strike with a swift and unsparing hand.

With the British Navy eliminated as a standard of comparison, we come to that of Germany. Is Germany a possible opponent, and must we match her navy ship for ship? She is, and we must. And we say this in a spirit of the most friendly appreciation of that great country and the genuinely pacific spirit of its present Emperor; and in the belief, moreover, that the Germans, like ourselves, would deplore any such deadlock between our national policies and their own, as would call for the stern arbitrament of war

Now it is a fact, well understood in diplomatic circles, that the whole of Continental Europe, and Germany in particular, regards the Monroe Doctrine with—well, to put it gently, with no friendly eye. The last-named country has vast and rapidly-growing commercial and industrial interests in the Latin-American republics and in South America. It is consistent with the proud, exclusive and self-assertive spirit of the German that he should wish to deal with any complications which might arise in those countries, directly—with the "mailed fist" let us say—rather than by proxy, as in the present Mexican crisis.

And across the Pacific lies that vast Empire of China, fabulously rich in its undeveloped resources, and a tempting prize for the greater European powers, as the events following close upon the Japanese-Chinese war so clearly proved. England, Germany, and France would have created "spheres of influence"—a phrase which, translated into its literal meaning and inevitable consequence, means partition and possession. As against this, we have proclaimed the policy of the "Open door" and "The integrity of China" Add to this the fact that we stand guard (with "mailed fist" if you please) at both portals of the key to the whole naval and commercial situation—the Panama Canal—and it will surely be evident that the United States should hasten to restore her navy to the second rank which it held in 1905, when it showed a positive superiority in strength over that of Germany, our possible opponent.

The question of the strength of a navy is a purely relative one. Our navy is strong or weak, solely in its relation to the strength or weakness of the navies of our possible competitors. The champion wrestler of the village green finds that he is a mere novice in the nearest town, and the subject for jeers and laughter in the arena of a cosmopolitan city

The citizens who, in October, 1911, gazed upon the fleet of 127 ships, including 31 first-class battleships, strung out in the Hudson River from Spuyten Duyvil to Forty-second Street, were not to be blamed if they believed that fleet to be a mighty aggregation of ships and men, ready and able to steam out past Sandy Hook and crush any fleet that could be sent against it. But if they had been told that the German fleet would have reached from Spuyten Duyvil to Staten Island, and the British fleet to Sandy Hook, they would have realized that naval strength, like the skill of the village wrestler, is strictly relative

Many years ago there was created a General Board of the Navy, with Admiral Dewey at its head, for the express purpose of studying this question and drawing up a programme of construction, which, if strictly followed, would maintain the United States Navy at such a standard of strength, that this country could pursue its policies without any fear of challenge or attack If this policy had been followed, the nation, in 1920, would have possessed a battleship strength of forty-eight, with the necessary cruisers, scouts, destroyers, submarines, colliers and supply ships in proper proportion.

"Such a policy," says a distinguished naval authority, "would have fulfilled all the necessary conditions; would have kept the Navy of the United States second to one only; *would in my firm conviction have discouraged the world race in armaments and ultimately tended to their reduction; and most assuredly would have tended to world peace;* for we have no blow to strike ourselves, and however strongly questions of race expansion, trade rivalries, and conflicting interests might urge other nations to strike us, the blow would never be struck, if we possessed a fleet which insured their defeat."

And what became of this programme? It went into the archives of the Government, and there it slumbers to this day And there it is destined to lie until the breath of life is breathed into it by the will of the people as expressed through their representatives in Congress.

The Naval Board programme was never adopted In the give-and-take of politics this, the most vital question affecting the welfare of the nation, was thrown into the political bag in common with such relatively minor matters as rivers and harbors, pensions, good roads and a hundred measures of purely local interest, and it came out of the shuffle cut down to a yearly quota of two battleships per annum. And in four out of the past eight years even that modest programme has been cut in half

Hence, if we are to retain our former standing, we must not only build up to the standard set by the Naval Board, but we must increase the yearly addition by the number of ships omitted. To bring our fighting line up to a standard of strength which will deter Germany from risking a conflict for the control of the Caribbean, we must build six dreadnoughts per year for the next three years and two or three per year for the years immediately following, carrying on this policy until Germany, realizing the hopelessness of any successful challenge of the Monroe Doctrine, shall desist

For it is a fact, too little understood by our Congress, that the ambitious German naval programme, inaugurated a few years ago, was aimed, not at England but at the Monroe Doctrine. Had we maintained the lead which we held in 1905, Germany would never have attempted to outbuild us, England would never have taken alarm at German activity, the added increase in her own and the German programmes would not have been made, and the so-called race in armaments would never have begun

It takes four years to build a battleship and train her crew to full efficiency If we build six battleships a year in 1914, 1915, and 1916, we shall have a first line of battle of 30 dreadnoughts in commission in 1920, and a second line of 16 pre-dreadnoughts In that year Germany will have a first line of 36 dreadnoughts, of which 11 will be battle-cruisers of lighter gun power and less heavily armored than our battleships, she will have a second line of 15 pre-dreadnoughts In a struggle for the command of the Caribbean, we would be operating within easy reach of naval bases—Germany would be nearly 4,000 miles from her own The odds would be decidedly in our favor; and under such conditions Germany would not risk the loss of her fleet in a great naval war She would never send her fleet across the Atlantic, except with a preponderance of naval force so great as to insure a certain and sweeping victory.

Similarly, if our exclusion of the Japanese brought on a war with Japan, involving a contest for the possession of the Philippines, we would be operating at a great distance from our naval bases, and, like Germany, should require a preponderance of naval force to insure success

Battleships are cheaper than battles, and the building of six dreadnoughts per year for the next three years would place us in a position which would effectually discourage the present race in armaments, maintain our policies beyond all fear of challenge, and preserve the peace indefinitely.

But the cost! Six dreadnoughts per year for three years would mean a total of eighteen The $180,000,000 pension bill for the present year alone would cover the cost.

Suggestion for Proviso High School

THE editor of this newspaper is a constantly delighted reader of the SCIENTIFIC AMERICAN, which is authority on American mechanics. We have often thought how beneficial and interesting it could be made if added to the studies in high schools Supposing that all the classes of the Proviso High School could be assembled at a stated hour on each day, and the principal, or a student chosen by him, would read an article from the AMERICAN, and discuss or elaborate on the subject treated, how it would be tapping a great mine of knowledge, for the benefit of the students. In the last issue is an article on the manufacture of automobiles, in the parts of which exact accurateness must be attained. It is intensely interesting and instructive The vital part of an automobile is its piston, and the AMERICAN describes the making of it in the following simple and delightful language:

> "The paper upon which the SCIENTIFIC AMERICAN is printed measures three one thousandths of an inch in thickness, a measure too small to be observed with the naked eye Yet an automobile manufacturer would hold up his hands in horror if you showed him a piston or cylinder that varied from his standard by anywhere near that amount Split this paper into six leaves; wrap one of the leaves around a piston of standard measure and you will have increased its diameter by only one one thousandth of an inch If then you could insert this piston into its cylinder, the cylinder would probably be rejected as too large, or if accepted, you would be informed that it represents the absolute limit of departure from perfect accuracy. We are accustomed to saying that there must not be a variation of a hair's breadth, believing that to be the acme of accuracy, but a hair's breadth may be three one thousandths of an inch or more, whereas in the important part of an automobile motor, one one thousandth of an inch represents the extreme variation permissible, and some parts have to be ground down to within half of a thousandth of an inch"

The article from which we quote is as intensely interesting throughout as is this excerpt. And there are a dozen leading articles equally as fine, treating of life, nature, science, mechanics and kindred subjects which would be prodigiously valuable and beneficial to the students of our high school. And it is so with every issue of the SCIENTIFIC AMERICAN.—*The Advocate* of Melrose Park, Ill.

The Flight Around the World

ALAN R. HAWLEY, president of the Aero Club of America, states that substantial assurances have been received from the Panama Pacific Exposition of the *bona fides* of the offer recently made for a successful flight around the world The $150,000 in prize money offered by the Exposition is actually on deposit in a San Francisco bank. The time for the race has been extended from 90 days to 120 days, and if no aviator wins the race before the expiration of that time, all those still in the air will be allowed to continue flying, and will be credited as winners in the order of their arrival, with certain penalties for each day they fly beyond the established limit. Supply stations three hundred miles apart will house gasoline, castor oil, and mineral oil. Aeroplanes may be shipped over the Atlantic provided any of the contestants feel that they do not care to engage in the hazardous feat of crossing the ocean. The original route from Asia to the western coast of North American has been abandoned, and in place of it by way of the Commander Islands has been decided upon with Sitka, Alaska, as the first landing place on the North American continent after leaving Asia Several cities have offered sums of money for the privilege of being designated as landing places.

The Coin Problem

THE "Problem of the Mint," discussed in our issue of February 7th by Theodore L. De Land, has drawn forth many answers. This problem may elicit a variety of replies. The following arrangement by Salem F. Kennedy is designed to point out the considerable variety of answers to Mr. De Land's query:

Let $x, y, z, \ldots s, w, m$, equal respectively the number of pieces of each minted value. Then

$$x+5y+10z \qquad 500s+1000w+2000m = 50000 \qquad (1)$$

$$\text{and } x+y+z \qquad s+w+m = 200 \qquad (2)$$

Multiply (2) by 250, subtract from (1), transpose and factor, and $249x + 245y + 240z + 225u + 200v = 250(s + 3w + 7m)$ (3)

The total value of the first member of this equation must have a factor of 250, since the second member has such factor. By simple inspection the first member (3) may be reduced to a multiple of 250 by assigning values to x, y, z, etc., as follows:

$x = 10$	2490
$y = 4$	980
$z = 2$	480
$u = 2$	450
$v = 3$	600
21	5000

Substituting 5000 for the first member and dividing (3) by 250, we have $s + 3w + 7m = 20$. $s = 3$, $w = 1$, $m = 2$ satisfies this equation. Whence the following number of pieces, and the total value, affords an *average* of $2.50, which is one of the conditions precedent. They are as follows.

A.	$x = 10$, value	$0 10
	$y = 4$, "	20
	$z = 2$, "	20
	$u = 2$, "	50
	$v = 3$, "	1 50
	$t = 1$, "	2.50
	$s = 3$, "	15 00
	$w = 1$, "	10 00
	$m = 2$, "	40 00
	28	$70 00, average $2.50

The number of pieces required being 200, this result must be increased by 172. By the familiar rule of alligation, comparing u, v, s, w, we have:

$$u : s \ . : 10 : 9$$
$$v : s \ . : 5 \ 4$$
$$u : w \ . : 10 : 3$$
$$v \cdot w :: 15 \cdot 4$$

The number of pieces of u, v, s, w may be increased as follows:

$$(u + s) = n(10 + 9) \qquad (4)$$
$$(v + s) = n(5 + 4)$$
$$(u + w) = n(10 + 3)$$
$$(v + w) = n(15 + 4)$$

for any value of n.

If n equals 1, 2, 3, 4, etc., we must have:

B.
$$u + s = 19, 38, 57, 76, \text{etc.}$$
$$v + s = 9, 18, 27, 36, \text{etc.}$$
$$u + w = 13, 26, 39, 52, \text{etc.}$$
$$v + w = 19, 38, 37, 76, \text{etc.}$$

By the arrangements of A and B, and the "little joker" t (the $2.50 coin), at least 100 different correct answers to Mr. De Land's problem may be written out at once. It is seen that arrangement A lacks 172 pieces that will average $2.50 each. The t value will supply the demand; giving the number of pieces substantially as in form A, with the exception that t will equal 173 instead of 1. Again, $10u + 9s$ produces the average, which added to collection A, leaves $153t$ to be supplied. Formula B may supply a very great number of substitutions, giving decidedly different results in each case, and all strictly correct. An exhaustive search will doubtless reveal correct answers into the hundreds.

Strictly speaking, there is no such thing as an algebraic formula for these problems. They all depend for solution on ingenious arrangement and close inspection.

Sir John Murray

FULL of years and honors, the marine biologist and oceanographer, Sir John Murray, met with sudden death on the 16th of March. Born and partly educated in Canada, he had passed most of his life in Scotland, and was one of the most conspicuous figures in the scientific world of Great Britain. He had celebrated his seventy-third birthday on March 3rd.

In the history of oceanography, especially on the biological side, two names are pre-eminent; Alexander Agassiz and John Murray. Agassiz, the Swiss-born American, collaborated in the task of placing before the world the epochal results of the "Challenger" expedition; and Murray, who took part in that expedition and edited nearly the whole of the fifty-volume "Challenger" report, paid a graceful tribute to the memory of his former colleague when, during a recent visit to America, he intrusted the National Academy of Sciences with a fund for awarding an "Agassiz medal" to persons distinguished in oceanographic research.

The "Challenger" expedition, which in the years 1872-76 carried out no less than 68,000 miles of deep-sea exploration, was the foundation of oceanography as a coherent branch of science. The submarine world was then, for the first time, revealed in a comprehensive way to the insight of man; and this voyage has accordingly been pronounced the most momentous geographic undertaking since the voyages of Columbus and Magellan. Murray, who had previously visited the Arctic regions in a whaler for purposes of biological research, was one of the two naturalists on the "Challenger" under Wyville Thomson, chief of the scientific staff. The failing health of the latter, and his death in 1882, resulted in throwing the whole burden of superintending the publication of the scientific results upon Murray. The execution of this formidable task, as well as his individual contributions to the great report, at once placed him in the front rank of marine investigators.

Thereafter, as the recognised leader in his field, he was obliged to bear the burden of public and private duties which always falls to the lot of the eminent specialist. He found time, however, for numerous researches on his own initiative, including expeditions to explore the Faroe Channel in 1880 and 1882; was a frequent contributor to scientific journals; and received abundant honors, culminating in the K.C.B. in 1898.

The greatest work of Murray's latter years was the execution, with the aid of able collaborators, of a bathymetrical survey of the fresh-water lochs of Scotland, the results of which were published in six volumes in 1910. In the latter year he induced the Norwegian government to send the exploring ship "Michael Sars" on a cruise of the North Atlantic, which proved to be one of the most fruitful enterprises of its kind ever undertaken. Murray defrayed the expenses of this cruise and took part in it. The results of this voyage furnished the bulk of the material for the splendid compendium of oceanography, "The Depths of the Ocean," published by Murray and Hjort in 1912.

It may be worth noting, merely as a curious observation, that Sir John Murray owed a little of his celebrity to the fact that he had numerous prominent namesakes. At the beginning of the present year there were living no less than nine "John Murrays" important enough to be included in "Who's Who," and it can hardly be doubted that each of them shone, to a greater or less extent, with light reflected from the others, since they all contributed in making their common name familiar to the public. The most eminent survivor of the nine is, probably, the London publisher, fourth of his name and line.

The Current Supplement

IN this week's issue of the SCIENTIFIC AMERICAN SUPPLEMENT Dr. H Lieber gives an account of the manufacture and uses of Blaugas.—Dr. L. H. Baekeland writes on the history of celluloid.—Dr. H. Lyster Jameson reports on recent advances made in the investigation of the cause of pearl production in oysters, and shows how such production has been artificially induced.—Our Paris correspondent contributes an article on prehistoric flint mines in Belgium.—Petroleum, its origin and its derivatives, is the subject of an article by D. T Day.—W. P. Davey gives an excellent review of the present status of our knowledge of X-rays.—Prof. H. Geiger's method of counting alpha and beta particles is described by its author.—The subject "Curbing the Mississippi" is treated by J. R Crowe.—The ocean-going, oil-burning, steam yacht "Cyprus," a remarkably fine vessel, is illustrated and described.—C. L. Foote writes on the use of concrete for roads.—The second instalment of G. A. Shook's article on Quantitative Colorimetric Analysis appears in this issue.

The Death of Dr. Edward S. Holden

DR. EDWARD SINGLETON HOLDEN, librarian at the United States Military Academy, died on March 16th, after an illness of some years duration. He was president of the University of California from 1885 till 1888; director of the Lick Observatory, 1888 to 1898. In July, 1902, he became librarian at the United States Military Academy.

Dr. B. E. Fernow, dean of the forest school of the University of Toronto, and Bristow Adams of the United States Forest Service, have just been elected president and secretary, respectively, of the Society of American Foresters, the only organization of professional foresters in the western hemisphere.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Shuman Solar Power Plant

To the Editor of the SCIENTIFIC AMERICAN:

Mr. Frank Shuman, in his letter on "Feasibility of Utilising Power from the Sun," published in your issue of February 28th, makes the statement: "Our method of generating heat from the sun's rays . . . has already reached an efficiency of 57 per cent." A little further on in his letter he states that the area of sunlight intercepted by the "absorbers" at his Cairo plant is 13,269 square feet, and that they develop 50 horse-power throughout a ten-hour day.

The total amount of energy reaching the earth from the sun is now generally accepted as being nearly two horse-power per square meter of surface perpendicularly exposed to the sun's rays. Allowing for the absorbtion of the atmosphere, at least one and one quarter horse-power is available at the earth's surface. Now as 13,269 square feet is approximately equal to about 1,232 square meters, the energy received by Mr. Shuman's "absorbers" while the sun is shining is equivalent to about 1,540 horse-power. I should like to know how Mr. Shuman figures out that 50 is 57 per cent of 1,540.

The little sun-motors with which John Ericsson experimented in New York during the seventies attained a far higher efficiency than Shuman is getting at Cairo, according to his own figures; yet Ericsson never claimed an efficiency of anything like 57 per cent.

Philadelphia, Pa. E. J. D. COXE.

Sir Henry Blake on the Rubber Congress

To the Editor of the SCIENTIFIC AMERICAN:

At the International Rubber Exhibitions of 1908 and 1911 papers were read by planters, chemists, and manufacturers on everything connected with the production of rubber, and discussions followed that brought to bear the experience of experts from every rubber-growing country in the world. Those papers and discussions were fully reported and reproduced in two books that remain valuable works of reference on every question connected with the industry, in which is engaged so many millions of capital.

As the Fourth Rubber Exhibition and International Rubber Congress opens on the 24th of June, I shall be glad if any persons who desire to read a paper on any subject connected with the growing, curing, or manufacture of rubber, or the possible expansion of its uses, or to take part in the discussions, will kindly communicate and register their names as early as possible with the honorary secretaries of the International Rubber Congress, 75 Chancery Lane, London, W. C.

HENRY A. BLAKE, G. C. M. G., *President.*

Youghal, Ireland.

The Problem of Our Navy

To the Editor of the SCIENTIFIC AMERICAN:

The armaments, whether naval or military, which at some period in civilization would be a great waste, may be the greatest necessity a few years prior to that period Who can say that the progress of the world has not at times been checked by the failure to preserve social development by an adequate protective force? And whether such a social growth is checked or crushed by a crude or a developed people, the loss to the world is beyond computation.

That human and property rights must be respected and protected is elementary. On all sides in every country we see conventions which prescribe the rules for human conduct, and because public opinion is insufficient to enforce these conventions, statutory laws are enacted prescribing penalties for their violation And the people have learned that in a country the enforcement of such a penalty cannot be left to the public in general or to chance, but very definite rules must be made governing the enforcement of the penalty. This has been our experience under the very best conditions where the vast majority of the people have the same standards and ideals. And yet many of the people to whom these facts are simple truths tell us that public opinion is altogether sufficient to regulate intercourse between the nations and foreigners whose standards customs and ideals have developed along divergent paths.

That the force of public opinion is growing cannot be questioned, but at the same time it must be admitted that it has not reached such a unitary development among the people of this world as to make it sufficiently uncomfortable for the individual who has transgressed. It would appear to be unsatisfactory to rely on public opinion to prescribe the rules of law between the countries of the world and their citizens, but we have little else to follow, for the rules of international law and the treaties cover only a few of the questions which may arise. While it consequently may be difficult to determine what the law should be in a given case, a much greater difficulty may be experienced in enforcing the law should an accepted rule be thought to apply. Each of the contending parties would have its national police consisting of army and navy, but the international tribunal which may render judgment in a court of arbitration cannot call on an international sheriff to carry out the judgment.

With the advent of an international sheriff the situation will be changed, for it will be possible to settle the disputes even when people may be unable to see justice in a rule prescribed by a majority of States with whose traditions the people are unfamiliar. But while we are working for the international sheriff, we must protect our physical and industrial development, if necessary by arms, in order that the finer things in our character may have a rich field in which to grow

Tenafly, N. J. EVERARD B. MARSHALL

Flying Around the World

To the Editor of the SCIENTIFIC AMERICAN.

While the writer agrees with your editorial of February 14th on "Flying Around the World" in that the $300,000 in prizes offered for the feat by the Panama-Pacific Exposition directors could be better devoted to aerodynamical research, yet that is also true in regard to many aviation prizes of the past, and it is hardly within the province of the Exposition directors to foster aviation so directly, although we will all agree that some one or several with the means should do so. Yet is it not appropriate that an exposition to represent the entire world's progress should offer a prize for such a trip around the world? However, it should not be compulsory that the same machine or engine be used throughout the trip, although an extra prize or first prize might well be offered for this.

The writer believes that the transatlantic flight for which Lord Northcliffe offers $50,000 is accomplishable with some of the present aeroplanes, with some changes and additions, and that this flight will be accomplished this year; also, that the round-the-world trip can and will be attained next year if certain advanced principles of aviation making for efficiency and safety are carried out; for it requires an average flight of only 200 miles per day to cover the distance of, let us say, 18,000 miles in the 90 days allowed; and some of the minor prizes for partial success are surely worth while also.

In regard to the transatlantic flight, the futility of attempting it with enormous, unwieldy, untried aeroplanes, as some propose, should be apparent. But suppose we take one of the most efficient of the present aeroplanes in regard to useful weight-carrying per horse-power and miles covered per gallon of gasoline. It should have two propellers of large diameter and slow speed of revolution, besides variable angle of incidence and blades inclined slightly forward for further efficiency, the increased amount of undisturbed air acted on in the flaring slip-stream of such a propeller more than compensating for the small loss from the slight angle of the thrust, as demonstrated with the celebrated Garuda propeller of Europe. The propellers should, of course, revolve balancedly in opposite directions by means of a single chain (as can be easily arranged). Then let us add another engine and the other set of such propellers, locating the latter above and below center, with clutches for shifting either engine to either set of propellers. The machine should, of course, be a hydroaeroplane, and for safety there should be lateral resistance surfaces co-operating with the rear vertical rudder for steering, but no fixed horizontal-rudder surface; while an automatic balancing device—instantly suspendable, however, might be added to relieve the aviator when tired

The writer is convinced that a safe aeroplane of more than twice the present greatest efficiency can be made, in fact, aerodynamic experiments already made show that this is possible to-day, and it seems more than probable that such a machine will win the prize for the round-the-world flight next year.

Livermore, Cal. ELMER G STILL

[NOTE.—Since this letter was written, figures in the "World Flight" have been changed, as shown on another page.—EDITOR]

Science in the Class Room

To the Editor of the SCIENTIFIC AMERICAN:

I have noted with much interest your recent editorials on the use of the SCIENTIFIC AMERICAN in the schools. Your letter of recent date asking for further particulars with regard to our use of your journal is also at hand.

A single illustration will serve to make clear our method of using the illustrations You have in the issue for December 27th an article on the building of foundations with hollow steel piles, concrete, and compressed air. I used this article with my class in physics as a further illustration of some work on the uses of compressed air which we had just finished. With the exception of Fig. 2, all the illustrations gave excellent results when projected on the screen with our balopticon Fig. 2 has no sharp contrasts and the pile driving machinery in the background did not come out clearly.

The present tendency in nearly every branch of science teaching is to break away from the nicely formulated, mathematical features of the subject and to give more attention to those applications in daily life which continually meet the student. The botany class no longer memorizes long lists of classifications Instead they are taught life processes and the effects produced by fertilizers and cultivation. Chemistry has ceased to be a series of test tube phenomena and relates itself directly to foods, sanitation, and the industries. More practical plumbing and fewer problems solved by using complicated formulæ, is the slogan of the forward movement in physics

Many schools are demanding a text-book in physics which shall be particularly fitted for girls Teachers are trying to fill the need by introducing such practical problems and illustrations as are found at hand. There is, however, a grave danger in collecting such material. To quote from the preface of a recent text-book "To eliminate or minimize the fundamentals while attempting to teach their applications is not to provide a 'royal road to learning,' but a fool's highway to pretentious ignorance. Pure and applied science are equally essential to a well rounded course The one alone is barren, the other, when not well founded in the first, is superficial, disconnected, and trivial"

The SCIENTIFIC AMERICAN is a type of journal which furnishes thoroughly reliable supplementary material. Not only is it practical, but the treatment is scientifically accurate With a modern opaque projection, the teacher has at hand a powerful aid to class instruction in any subject. A few well chosen pictures projected on the screen make the text-book material concrete and show at a glance the various commercial and industrial applications A good many students will be stimulated by such discussions to read further along such lines.

Nearly all the illustrations appearing in the SCIENTIFIC AMERICAN will give good results with an opaque projector as they stand Where the print is too dark or the contrasts are not sufficiently sharp, the portions to be brought out can be covered with Chinese white and painted over with water colors

The following is a suggestive list of some of the topics which the writer has found helpful in high school:

1. Aviation. No text-book in physics gives an adequate description of this subject A few minutes with the files of the SCIENTIFIC AMERICAN will provide ample material for one or more lectures. Nearly every issue contains one or more illustrated articles

2. Air Pressure and the Atmosphere Air Lock, November 30th, 1912. Pneumatic Tampers, December 7th, 1912. Whistling Buoy, December 14th, 1912. Insufflation Apparatus, December 28th, 1912. Pneumatic Elevator and Grain Lift, July 19th, 1913. Steel Pile Driving, December 27th, 1913 Novel Uses of Compressed Air, July 5th, 1913. Soot and Dust Fall, January 17th, 1914.

3. Automobile and Gas Engine The annual motor numbers, and following issues: Farm Tractors, June 7th, 1913 Diesel Engine, September 20th, 1913

4. Bacteriology Vaccine, June 14th, 1913 Typhoid Fly, July 13th, 1912. Pasteur Institute, December 27th, 1913

5. Cement and Concrete Cement and Its Uses, SUPPLEMENT, March 18th, 1911 Application to Waterways, April 26th, 1913 Trench and Tube Method, March 29th, 1913 Assuan Dam, February 18th, 1913

6. Electricity Steel Furnace, June 7th, 1913 Electric Welding, December 1st, 1913, to November 22nd, 1913 Dussaud's Cold Light, May 31st, 1913 Safety Lamp, January 25th, 1913

7. Heat Solar Power Plant, January 25th, 1913. Liquid Helium, December 27th, 1913

8 Hydro-electric Plants Mississippi River, August 10th, 1912, to September 13th, 1913. California Plants. SUPPLEMENT, August 2nd, 1913

9 Hydrogen. Manufacture for Balloons, December 13th, 1913

10 Oxygen Oxyacetylene Torch, June 14th, 1913, to October 18th, 1913 Living Animals Transported by Oxygen, January 21st, 1911. Pulmotor, February 1st, 1913

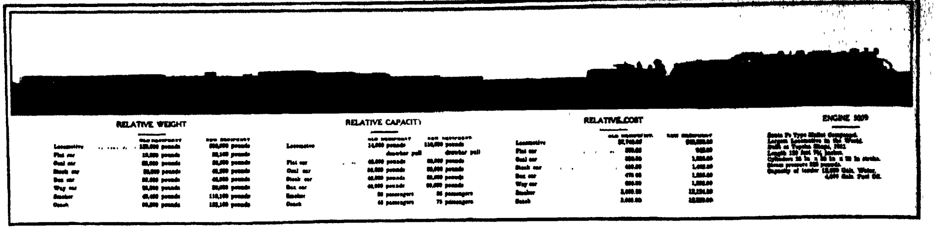
The *Reader's Guide* to the current periodicals will furnish a list of all articles on these or other subjects in which the teacher or students are interested

An occasional article treating some industry from the point of view of the chemistry and physics involved, well illustrated and written in a simple, direct style, would attract our students The natural growth in the circulation of the SCIENTIFIC AMERICAN resulting from such excellent reading habits being formed early in life is obvious.

May I suggest that if you find it practicable to take up such work, your assistants would find it advantageous to experiment a little with opaque projections?

RAY W KELLY.

Pacific Grove High School, Pacific Grove, California.



Santa Fe demonstration train, showing the old (1881) and the new (1911). This shows the increase in the weight of equipment to which the airbrake was successfully adapted.

George Westinghouse

A Great American Inventor

IN the annals of industry it would be difficult to find a personality that fulfills the popular ideal of an inventor so completely as the late George Westinghouse. He began life as a poor boy, he died a wealthy man, thanks to his own efforts His was a strong, hopeful, fighting spirit, and to it he owed as much of his remarkable success as to his wonderful intellectual gifts. The perusal of his life must ever be an encouragement to characters less forceful than his. He began inventing while he was still a school boy; he succeeded brilliantly before he was thirty; he braved what seemed to be invincible opposition, and triumphed; he surmounted all the obstacles which, from time immemorial, all revolutionists—and he was a great revolutionist in modern industry—must surmount if their ideas are to be carried into effect.

Students of eugenics will find in Westinghouse's parentage evidence enough to support their views that great intellectual ability is an inheritable characteristic. He was born on October 6th, 1846, the son of an inventor and of a manufacturer of agricultural implements. He was brought up in an atmosphere that was well calculated to foster in him that marvelous ability which he later displayed Even as a school boy in Schenectady he worked away in his own little shop or in his father's works. At fourteen he had made a model of a rotary engine—a harbinger of the steam turbine with which his name was to be linked in later life.

There is something inspiring in the way that he bounded along to success when he could hardly have put aside his knickerbockers. At seventeen a cavalryman on the Union side in the great rebellion, and a few months later nothing less than an assistant engineer in the United States Navy! It reads almost like a novel.

What his mentality must have been when he was just old enough to vote, one gathers from his abandonment of a classical course in Union College "You are wasting your time here," the president of that institution said to him. "A classical course is nothing for you. You know all that you can learn here of mathematics. You have a genius for invention Cultivate it and you will become a great engineer. The college is holding you back." And so he left college and pursued his way alone. Had he started life in our day he probably would have listened to the lectures of great professors in one of our higher technical institutions, but in those days there were no technical schools in which a man of his caliber could learn anything of real technical worth

It was not long after he left Union College that he invented the airbrake, with which his name is more tenaciously connected than with any other of his numerous inventions. The idea came to him, it is said, as the result of a head-on collision between Schenectady and Troy, which he witnessed.

Obviously meritorious as the invention was, railways would have none of it. Every great invention means a great revolution Revolutions in industry or transportation are no more relished by presidents of manufacturing companies and railways than a Czar relishes nihilist bombs. Westinghouse had to stub his toes more than once in kicking the brick that is concealed beneath the high hat of prejudice, against the "it can't be done" attitude of most so-called business men. He succeeded because he brooked no resistance, because he believed in himself and in his invention. An inventor who is a pessimist is doomed to failure. Mr. Ralph Bagley pledged himself to pay the cost of the first airbrake apparatus that was ever installed on a railway train. But if it had not been Mr. Ralph Bagley it would have been some one else. Tradition has it that the first trial of the Westinghouse airbrake was quite unpremeditated. The train on which it had been mounted rounded a curve; a heavily loaded wagon was wedged in the tracks dead ahead of him; the distance was so small that the ordinary handbrakes could not possibly stop the train in time; only the new airbrake, hitherto untried in actual practice, could possibly avert a disaster. The passengers were thrown out of their seats; for the first time in history a train had been stopped by air, and the first safety appliance in modern railroading proved its worth.

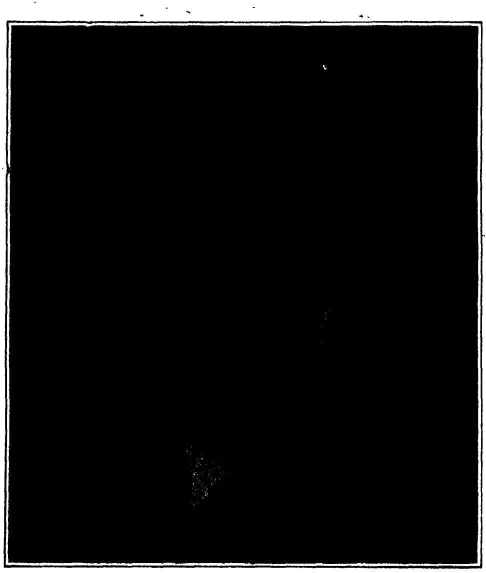


Photo. by Gessford.

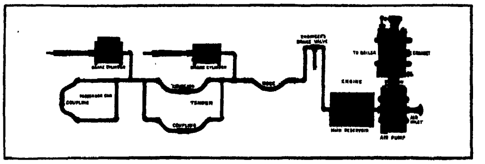
The late George Westinghouse.

Westinghouse was only twenty-two then. That initial success, infinitely more convincing than a hundred successful experiments before critical and skeptical railway officials, started him on the road to success. The Pennsylvania was the first railway to adopt the idea of stopping trains with air. A patent was granted in 1869, and a small shop employing one hundred men began the creation of an industry in which tens of thousands are now employed the world over, and in which tens of millions are invested.

The greatness of an invention must be measured by its economic effect. Gaged by that standard the airbrake is one of the greatest contrivances that ever was conceived by man. It made the modern high-speed train possible; it gave a new impulse to railroad transportation. It is not so difficult to devise engines which will haul cars at the rate of sixty, seventy, eighty miles an hour through space Even on the old Stockton and Darlington road, the first commercial railway ever built, Stephenson's early locomotives sometimes attained a speed of sixty miles an hour. But high speed may not be maintained unless the on-rushing vehicle can be quickly stopped. When his brake appeared the fast train really became possible. In a very real sense, therefore, Westinghouse made it possible to travel in eighteen hours from New York to Chicago.

After the airbrake had been definitely introduced, Westinghouse began to improve it. He was always introducing improvements. Indeed, his personal interest in its perfection did not terminate until about 1901, and even after that he supervised the engineers who adapted the brake to the heavier and faster passenger trains, and the longer freight trains that railways were introducing.

In its development in the hands of Westinghouse himself the airbrake passed through what may be called the "straight-air," "plain-automatic," "quick-action-automatic" and the "high-speed brake" epochs.



The early form of the straight airbrake.

The latest type is known as the electro-pneumatic brake, which will be described and illustrated in an article soon to be published in the SCIENTIFIC AMERICAN. In the evolution of the airbrake, Westinghouse made it a point always to meet existing conditions. Hence, while each one of the types mentioned marked a wonderful advance, not a single airbrake appliance has ever been brought out that would not couple up and work in complete harmony with all prior equipment. Up-to-date airbrake equipment has been furnished for a total of approximately 2,800,000 freight cars, 86,300 passenger cars, and 78,400 locomotives. If this rolling stock were coupled into one solid train, it would encircle the globe on the parallel of Pittsburgh one and one fifth times.

The great changes in braking equipment indicated by these types were necessitated by economic conditions. Very heavy locomotives and heavy passenger cars were necessary to meet the increasing demands of the traveling public, and very long freight trains were required to haul goods long distances cheaply. In the '70s freight cars weighed 10 tons and locomotives 25 tons, with a tractive effort of 7,000 pounds. The average train at that time consisted of not more than 15 or 20 freight cars and four or five passenger cars. In the next epoch freight trains increased to fifty cars—an increase which Westinghouse met by redesigning freight brake equipment. It was thought that the maximum length had been reached; yet to-day freight trains are sometimes 130 cars long. The increased length and the new hazards created were again met by improvements. If these remarkable advances in transportation—made possible in large part by increasing the efficiency and flexibility of the airbrake—do not prove that Westinghouse's greatest invention is more than a mere safety device, we have only to turn to the subway of New York for additional evidence to the contrary.

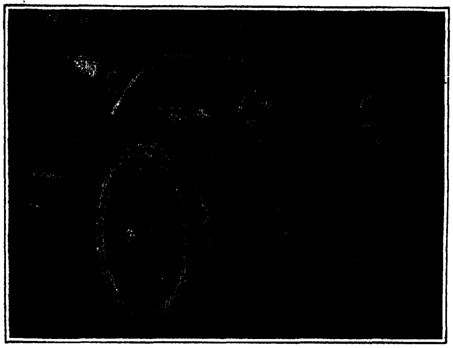
In 1907 the New York subway handled 258,000 passengers per day; in 1908, 704,000 passengers per day. It was obvious that the transportation facilities had to be improved. It was also obvious that the subway itself was a permanent structure, and could not be enlarged. There was just one possibility of meeting the congestion—to lengthen trains from five to seven cars. To accomplish that feat it was necessary to devise an entirely new type of airbrake. When that was done the Interborough cars ran seven-car trains in 1908, and handled an average of one million passengers daily. But by 1911 the traffic had again become so congested that ten-car trains had to be introduced Again the airbrake equipment had to be improved. This was accomplished by means of the electro-pneumatic brake At the same time the spacing of the block signals was reduced so as to provide for 90 seconds headway. What the improved airbrake has meant to the Interborough Railway system was thus set forth by a prominent official of the road at a recent meeting of the American Society of Mechanical Engineers:

"The Interborough Rapid Transit Company is now carrying as high as 1,200,000 passengers per day in the subway. To go back to the airbrake equipment used only four years ago would mean that 400,000 of these people would have to walk, as it would be an utter impossibility to operate a sufficient number of trains over the road to carry them."

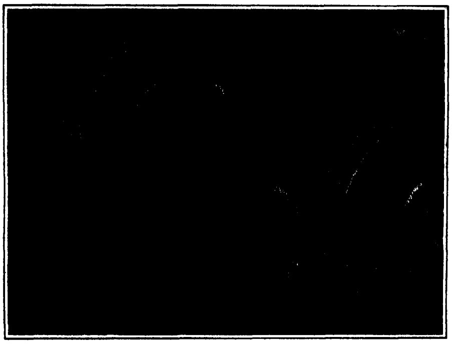
Soon after the airbrake was successfully introduced, Westinghouse turned his attention to railway signals. Only those familiar with the history of railroading know that he was the father of the modern automatic signal. At first he used compressed air to operate the signals, later electricity. Thus the modern electro-pneumatic signal was created.

It is curious that the more important of Westinghouse's railway inventions had for their primary object the saving of human life But the lives to be saved were not merely those of passengers who trustingly paid their fares and took their plush seats, but also of trainmen themselves The automatic car coupler, he felt, minimized the danger of connecting cars, but it did not eliminate the danger entirely Steam and air pipes had also to be connected, and the man whose duty it was to couple them might lose his life if a hasty engineer opened the throttle too soon. So Westinghouse invented, comparatively late in life, a device which would not only couple cars, but also pipes—the whole in a single automatic operation Perhaps the greatest application of these automatic couplers is to be found on the New York subway—great not in the sense that many cars are utilized by the system, but that more than a million passengers a day are carried, whose lives are in a measure dependent on tight joints The order for the subway equipment came to Westinghouse when the idea of automatically coupling the pipes of an electric train was more or less in embryo. Yet so

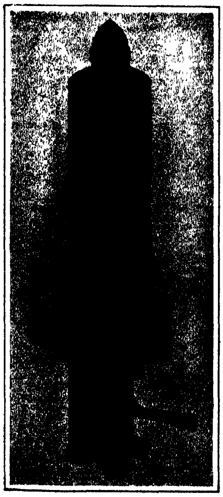
(*Continued on page 273.*)



The airspring applied to the automobile.

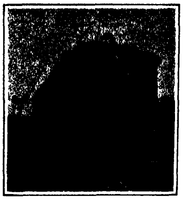


The Melville-Macalpine-Westinghouse reduction for turbines.



Sectional view of the airspring.

The automatic air and steam coupler.



A single-phase locomotive.

Baltimore and Ohio Railroad's 240-ton articulating compound locomotive equipped with Westinghouse airbrake.

The all-electric interlocking motor-operated signal.

SOME IMPORTANT INVENTIONS WITH WHICH THE NAME OF GEORGE WESTINGHOUSE IS CONNECTED AS INVENTOR OR ENGINEER

The Heavens in April

Discovery That the Sun as a Whole Possesses a Magnetic Field

By Henry Norris Russell, Ph.D.

THERE is probably no one publication which contains in small compass so much new and interesting astronomical material as does the annual report of the director of the great Mount Wilson Observatory. The account of its activities during 1913, which has recently been published, gives in summary form a list of no less than seventy-two results of the year's work, of varying importance, but without exception valuable additions to the sum of astronomical knowledge.

First in the list is a discovery of great importance—made public, with the detailed evidence, some months ago, but not hitherto discussed in these columns—namely, that the Sun as a whole possesses a magnetic field. In other words, the Sun acts like a huge magnet, just as the Earth does. If one could imagine a compass needle to be carried from the Earth's surface to the Sun's, and protected against the destructive effects of temperature, it would point, approximately, at least, toward the Sun's north pole, and the force which caused it so to point would be some fifty times as strong as on the Earth The detection and confirmation of this magnetic force is a triumph of observational precision and skill. The methods of investigation are similar in nature to those which proved the existence of strong magnetic fields in sun-spots, but the quantities which have to be measured are so small that the greatest care was necessary in their determination.

We may recall that, when a luminous vapor is placed in a magnetic field, and viewed in the direction in which the magnetic force runs, the lines in its spectrum, previously single, appear to be split up into very narrow pairs, whose separation increases in proportion to the strength of the magnetic field. But this timing of single lines into doublets is not the whole story. The two component lines of the pair have certain properties which are not found in ordinary light; their light is "circularly polarized." Without stopping to define the exact physical meaning of this term, we may pass to the practically important fact that it is possible to set up an apparatus composed of mica and Iceland spar (and called a quarter-wave plate and Nicol prism), such that, if it is placed in a certain position, the light of one of the two components of the magnetically doubled line passes through it freely, while that of the other will not get through it at all. By turning part of the apparatus at right angles to its former position, we can reverse the situation, blotting out the line which was formerly visible, and bringing into view the one which had before been extinguished.

Such a change in the arrangement of the apparatus, however, makes no difference in its action upon ordinary light. A double line which did not owe its separation to magnetic action would always appear double, and neither of its components could be blotted out at will

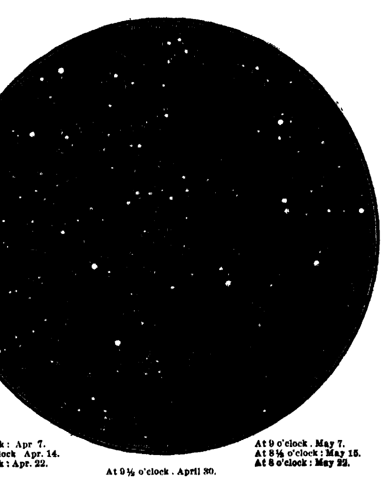
It was in this way that Prof. Hale showed that the double lines which appear in sun-spots arose from the action of a powerful magnetic field, which is strong enough to separate many lines into pairs which can be easily separated with a powerful spectroscope, though not all the lines, for the same magnetic field influences some lines much more than others.

The last year was one of minimum sun-spot activity, and hence a very favorable time for the study of the Sun's general magnetism, without interference by the powerful effect of the spot disturbances. Theoretically, it may be shown that if the Sun's general magnetic field were strong enough, the lines in the spectrum would be split up into doubles, such as we have just described, when the light came from points about halfway between its equator and its poles, but not if the light came from either pole or from the equator. Though the doubling would occur with light from either the northern or southern hemisphere, it would be found that the two doublets were not alike Setting up an apparatus such as has been described, and adjusting it so that in the light from some point north of the Sun's equator, the component of the doublet which lay nearest the red end of the spectrum was transmitted, and the violet one extinguished, we should find, on passing light from a point south of the equator into the same apparatus, that the violet component was now transmitted, and the other one blotted out. If the magnetic field under investigation was weak, the pairs of lines would be so little separated that they could not be seen double—they would overlap. But, even so, the edges of the compound line, where one of the components stuck out beyond the overlapping portion of the other, would be circularly polarized, and, by proper manipulation of our apparatus, we might extinguish first one edge and then the other of the compound line, and thus cause a slight shift of its middle toward the unextinguished edge.

This last phenomenon is just what has been found in the Sun. The apparatus was set up in such a way that in a series of parallel strips of spectrum photographed simultaneously on the same plate, the red and violet edges of the line should be alternately extinguished. A line which showed the effect, even to a very small degree, would therefore exhibit something resembling a zig-zag appearance, while unaffected lines would seem straight across all the strips.

Upon making the observations, the majority of the lines showed no effect, but a few not very conspicuous ones gave distinct evidence of a shift—just big enough to measure, but changing from one hemisphere of the Sun to the other, and also with changes in the arrangement of the polarizing apparatus, in exactly the way demanded by theory. The actual amount of the shift is exceedingly small, being, even for the most affected lines, only about 1/4,000th in part of the distance between the familiar pair of yellow lines of sodium; but the numerous and very precise measures of the Mount Wilson observers place its reality beyond doubt. Comparison with laboratory experiments which gave the separation of the two components of the line by powerful magnetic fields, showed that the magnetic forces acting in the Sun were about eighty times as strong as those on the Earth's surface. This is a preliminary value, reduced somewhat by later observations.

Since other lines in the spectrum do not show any such effect, Prof. Hale concludes that the strength of the magnetic force is greatest at the bottom of the solar atmosphere, and diminishes upward. There are various reasons to suppose that the lines which show the effect are produced in the lower part of the atmosphere.



At 11 o'clock: Apr 7.
At 10½ o'clock Apr. 14.
At 10 o'clock: Apr. 22.

At 9½ o'clock. April 30.

At 9 o'clock. May 7.
At 8½ o'clock: May 15.
At 8 o'clock: May 22.

NIGHT SKY: APRIL AND MAY

The Heavens.

The winter constellations are now fast vanishing from our skies. At the hour chosen for our map, Orion and Taurus are practically gone, and Auriga, Gemini, and Canis Minor are low in the west. Leo and Virgo are high on the south and southeast, with the mighty length of Hydra below them bearing the smaller figures of the Cup and the Crow upon its back. Scorpio is rising in the southeast, Ophiuchus in the east, and Lyra in the northeast. Hercules, Corona, and Boötes are higher up in the eastern and northeastern sky. The Great Bear is high in the heavens, just north of the zenith. Lower down are the Little Bear and the Dragon, and still lower Cassiopeia and Cepheus close to the horizon.

The Planets.

Mercury is a morning star all through April, but is best seen during the first week of the month when he is farthest from the Sun. His greatest elongation (or apparent distance from the Sun) is 27 degrees 46 minutes, on the 7th; and on this date he rises at 4:45 A. M., and is easily visible in the morning twilight.

Venus is an evening star, still apparently pretty near the Sun, though really far behind him. She sets at about 7:50 P. M., in the middle of the month, and is easily visible shortly after sunset.

Mars is evening star in Gemini, moving eastward into Cancer at the end of the month. He has greatly diminished in brightness, and appears about equal to Pollux, south of which he passes at about 5 degrees distance in the middle of the month. Jupiter is morning star in Capricornus, rising about 3:30 A. M. on the 1st, and 1:40 on the 31st.

Saturn is evening star in Taurus, setting a little after 10:30 P. M., in the middle of the month.

Uranus is in Capricornus, observable only in the morning hours. Neptune is in Gemini, and is in conjunction with Mars on the 21st, being 2 degrees 34 minutes south of him. The distance between the planets is too great to make this conjunction of any use to the amateur in identifying Neptune, for many faint stars, resembling the planet in a small telescope, will be nearer Mars than Neptune is.

Mars is in quadrature, 90 degrees east of the Sun, on the 10th, and Neptune on the 16th.

The Moon.

First quarter comes at 3 P. M. on the 3rd, full Moon at 8 A. M. on the 10th, last quarter at 3 A. M. on the 17th, and new Moon at 6 A. M. on the 25th. The Moon is nearest us on the 10th, and farthest away on the 23rd. As perigee comes very near full Moon, we may expect unusually high spring tides at that time.

As she makes the circuit of her track, the Moon comes into conjunction with Saturn on April 1st, Mars (pretty closely) on the evening of the 3rd, Neptune on the 4th, Uranus and Jupiter on the 18th, Mercury on the 23rd, Venus on the 27th, and Saturn again on the 28th.

Delavan's comet is now out of sight, as we are on the far side of the Sun; but the latest calculations confirm the earlier ones in showing that it is still a long way off, and approaching the Sun, and that it will probably be visible to the naked eye, and perhaps conspicuous, next autumn.

Princeton University Observatory.

Finding Rare Metals by Spectroscope

MINERAL waters are easily analysed by means of the spectroscope, as shown by M. Jacques Bardet, and this is likely to prove one of the best methods for this work. He sends a beam of light through the water to be analyzed and thence through the spectroscope prism, in order to permit of examining the spectrum, this method revealing very minute traces of metals. He finds the most varied metals in different samples of mineral water, and even the rarest metals, such as germanium and gallium, which are very rarely found in nature.

An Agricultural Car in the Philippines

THE Bureau of Agriculture in the Philippines has adopted the plan, familiar in the United States, of sending a car from place to place over a railway system, specially fitted out for exhibitions, demonstrations and lectures on agricultural subjects. During a month's trip over the Manila Railway stops were made at twenty towns, and in spite of unfavorable weather the car was visited by over 12,000 people, while more than 5,000 attended the nightly illustrated lectures. Improved seeds and a large amount of agricultural literature were distributed.

How the Kinematograph Facilitates the Study of Tissue

Affording Once Undreamed of Opportunities for Detecting Rapid Embryonic Changes

By Genevieve Grandcourt

IN speaking recently before the British Association at Birmingham, Sir Oliver Lodge expressed the opinion that in the interplay of physical, chemical and mechanical forces, "Life introduces an incalculable element. The vagaries of a fire or a cyclone could all be predicted by Laplace's calculator, given the initial positions, velocities, and the law of acceleration of the molecules; but no mathematician could calculate the orbit of a common housefly. A physicist into whose galvanometer a spider had crept would be liable to get phenomena of a kind quite inexplicable until he discovered the supernatural, i. e., literally superphysical cause."

It is the study of the very beginnings of discernible difference between animate and inanimate, of life from its earliest unfolding under the microscope (for example, of the chicken in the egg) that is the province of modern embryology.

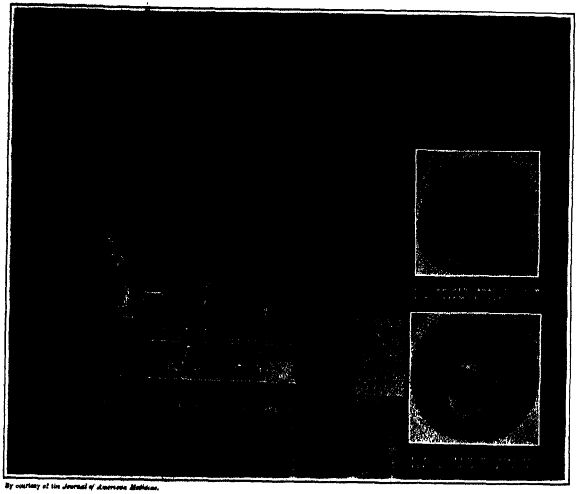
Impossible as the development of this science would have been without the relative perfection of the microscope, two other discoveries of recent time have been enlisted in its service; one, the demonstration by Harrison in 1907 that the nerve-fibers of the frog may be artificially cultivated; the other, the moving picture, which affords once undreamed-of opportunities for the detecting of rapid changes in the evolving embryo—changes which may have a very great bearing upon now obscure problems of the origin of life and in pathology.

For a time, experiments in artificial tissue-growth were confined to extracting small particles of living tissue, and causing the proliferation of its cells *in vitro*, that is, in the same way that colonies of microbes are multiplied for bacteriological purposes. The artificial cultivation of the entire embryo was undertaken more recently by Drs. McWhorter, Whipple and Prime of Columbia University.

The method adopted was to put fresh hen's eggs into a specially prepared incubator heated to a temperature of from 99.5 to 104 deg. Fahr., and keep them there from one to two and a half days; then under aseptic conditions to remove the blastoderm, i. e, that portion of the fertilized reproductive cell (ovum) which develops into the embryo and under appropriate conditions, into a living thing.

Early experiments showed that there was difficulty in removing the blastoderm from the egg in such a state as to permit of its artificial growth if it was abstracted either before the so-called "head-fold" had had time to appear, or after the egg had been incubated for a longer period than sixty hours. Success, however, has been had with much older embryos.

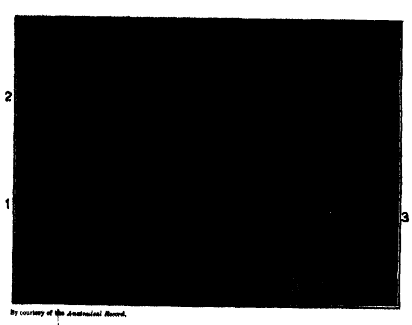
If the egg had been in the incubator for a day and a half, and the course of its development was regular, the blastoderm was found to lie on the surface of the yolk, as shown in one of the accompanying photographs. It was then separated from the yolk with scissors, and while lying in a salt solution, was freed from any extraneous matter (such as the granules of the yolk, etc.) which might adhere to it. On being transferred to the glass cover of the chamber in which it was subsequently to grow under the heat of the oven, it was drained of the salt solution, and over it were placed a few drops of fowl's blood; this blood having, meantime, undergone preparation as plasma through being deprived of its cells by centrifuging, and then refrigerated. The blastoderm so prepared was left exposed to the air long enough for the blood-plasma to coagulate, and thus hold the specimen firmly to the glass. One of our illustrations shows the blastoderm after the glass cover has been inverted over the glass cell or chamber, and made "ready for microscopic study and photography" The subsequent process of unfolding is analogous to nature's course in the egg.



By courtesy of the Journal of American Medicine.

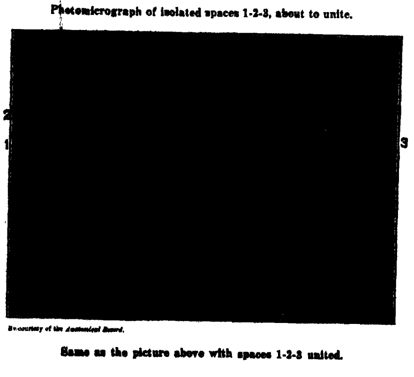
Apparatus for kinematographing tissue growth. A, modified incubator; B, optical bench; C, kinematograph.

One of the many unsolved problems in embryology hangs about the origin and unfolding of the middle of the three layers of the primitive embryo (mesoderm), out of which are evolved the connective tissues, blood vessels and lymphatics. Observations have been made of many forms of life with a view to obtaining light upon the subject, the most trustworthy with regard to the lizard and the chicken. It seems pretty well established that the *mesoderm* unfolds by a uniform process from amphibia to mammals. As soon as it is visible as a distinct layer, two classes of cells are to be discerned in its structure, one of which sets busily to work to form a network of cavities which are the starting-points of the earliest blood vessels.



By courtesy of the Anatomical Record.

Photomicrograph of isolated spaces 1-2-3, about to unite.



By courtesy of the Anatomical Record.

Same as the picture above with spaces 1-2-3 united.

With the expectation that the artificially developed blastoderm would throw light upon the evolutionary process of the entire vascular system, these cavities or spaces were studied under the microscope and photographed. They appeared of unequal size and shape; sometimes, indeed, merely wandering off into undifferentiated tissue, but often having easily traced boundaries Under the magnifying glass, these spaces were seen undergoing constant alteration of size and outline, meeting and flowing into each other—forming channels. At a certain point, the change became too rapid to be followed, and suddenly the observer looked to find the spaces had been swallowed up. Cells or groups of cells were moving in the newly formed channels, the walls of which began to dilate, demonstrating that there was pressure of fluid within When bordering channels met in the form of a net-work, the first heart beat was established.

At this point began an oscillating motion of the cells in the lumen of the channels, and, the circulation being under way, these cells could be seen "breaking off from cell masses," when they "suddenly shot through the channels as if an obstruction were suddenly removed," affording in this way "a remarkable example of the effect of the hydrodynamics of the pumped fluid in these channels."[1]

Observations made from the time of the initial heart beat, and especially on the development of the first two folds of the heart, are essentially technical

In elaborating the study, the obvious

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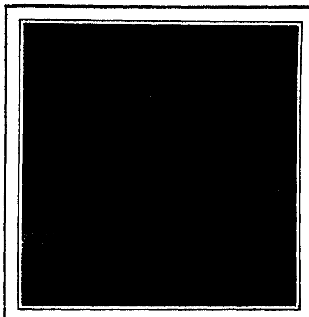
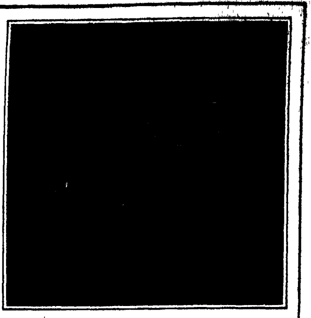
[1] *Anatomical Rec.*, Vol. 6, No. 3, Mch., 1912.



A motor-propelled fire engine racing through the snow.

The Motor-driven Commercial Vehicle

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The Editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles.



Engine fitted with front drive, virtually a two-wheeled tractor.

Modern Motor Fire Apparatus

By Ross Babcock

A LITTLE more than three years ago motor-propelled fire apparatus was a genuine curiosity. At the end of the year just closed we had 8 important cities without a single piece of horse-drawn apparatus; all motors. Others rapidly are following their lead as is evidenced by the fact that there are now more than 820 cities that have installed gasoline fire fighting apparatus; their total equipment includes more than 2,100 separate pieces. And the investment represents, in round figures, more than $10,500,000! The amount has almost quadrupled in as short a time as 18 months.

Nor are the big cities the only ones that have seen the light and turned their horses out to green pastures. Some of the little ones are just as progressive. Take the cities of Springfield, Mass., and Macon, Ga., for instance. Springfield is about sixtieth in the country in point of size, but it ranks third in the proportion of motor-propelled fire apparatus Springfield's population is approximately 89,000, yet it has no less than 32 pieces of motor-propelled fire apparatus. Macon's inhabitants number about 40,665—Macon has 11 gasoline fire wagons.

According to the latest available figures, there are only 6 States that have more than 100 pieces of motor fire apparatus each. Of these 6, New York leads with 253 pieces of apparatus distributed among 66 cities and towns; the others in the proper order are as follows: Massachusetts, 227 machines in 83 cities; Pennsylvania, 155 machines in 78 cities; California, 149 machines in 53 cities; Ohio, 146 machines in 44 cities; New Jersey, 145 machines in 55 cities.

Economy of operation is one of the principal advantages of the gasoline fire engine; the first cost is practically the last cost, barring accidents, of course, and running expenses which in any case are purely nominal alongside the running expenses of horse-drawn equipment Take the case of the city of Springfield for instance. The Fire Commissioners have prepared a chart which shows (from experience and not in theory) that the average cost of maintenance of 7 pieces of motor-propelled apparatus used as a basis for comparison was $161.89 for a whole year, during which time the average number of alarms responded to by each piece was 140. The cost of horse-drawn vehicles, on the other hand, was $524.18, and the average number of alarms was but 125. The figures speak for themselves.

Chief W H. Jones of the Richmond, Va., Fire Department, said in a recent paper " . . . Its upkeep (referring to a triple combination chemical, pumping engine and hosecart) has been only about 6 per cent of the cost of the horse-drawn, while its efficiency has been 60 per cent greater and it covers double the territory formerly assigned to the horse-drawn apparatus of this particular company."

Here is a conservative estimate of cost made by a reputable manufacturer:

HORSE-DRAWN STEAM FIRE ENGINE.

Feed for four horses	$600
Shoeing horses	72
Veterinary and medicine	80
Blankets, brushes, etc	80
Driver for hose wagon, also stoker and engineer for steamer	2,700
Coal for steamer	75
Harness repairs	40
	$3,647

MOTOR-DRIVEN PUMPING AND HOSE CART.

Tire expense	$120
Gasoline and oil	45
Battery charging	3
	$168

Annual saving of motor apparatus, $3,479.

These figures do not include the cost of building maintenance, which, with motor apparatus, must be less than with horse-drawn, for less room is required for the former.

Let us examine the records that have been made by some of the more modern fire apparatus and in this way bring to light another and very important advantage. For instance, these figures come from the Fire Department of the city of Colorado Springs: Loss in 1911, when it had no motors, $27,000; loss in 1912, with three pieces of motor apparatus, $8,000. Any number of cities report that since the installation of motor fire apparatus, fire losses have dropped off, in several cases by as much as 75 per cent, and in the majority by at least 50 per cent. The city of Pontiac, Mich., estimates that the saving in fire losses in one year paid for its motor equipment. And what is more significant, fire insurance companies look with favor upon such apparatus, and in a noteworthy number of instances material savings in premiums have been effected by property holders.

Motor-propelled fire apparatus itself can be divided into six classes, and in this respect it is pertinent to add that the building of such vehicles requires experience and a square look at the fact that the fire apparatus builder's problems are not those of the ordinary commercial vehicle builder any more than they are those of the pleasure car builder. The successful motor fire wagon must be essentially more or less of a cross between the two. For with the heavy fire engine we have the weight of the commercial vehicle requiring heavy and substantial construction combined with a fair portion of the speed of the pleasure car. Motor trucks seldom exceed 16 or 18 miles an hour, whereas fire vehicles attain speeds anywhere between 35 and 60 miles an hour. Hence their design suggests a number of delicate problems which can only be solved after exhaustive study and experiment.

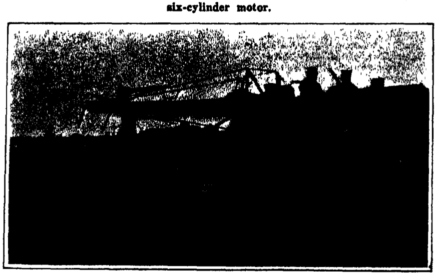
The six classes of motor fire apparatus include briefly the chief's light runabout, which may or may not carry auxiliary apparatus; the chemical wagon; the ladder truck; the hose wagon; and the pumping engine. The latter may be subdivided to include converted steamers, which are steam pumping engines with gasoline tractive machinery, and gasoline pumping engines which also are driven by gasoline engines. Another division includes combined pumping and chemical engines which also, perforce, carry a quantity of hose.

The chemical engine may range in size from an almost miniature machine with a single small tank to a mammoth six-cylinder machine capable of fighting a really stubborn blaze—and extinguishing it.

Due to the disinclination of municipalities to scrap steam pumping engines which still are useful, quite a number of makers have evolved chassis upon which these pumps can be mounted and so serve out the remainder of their useful lives. In some designs the steam apparatus is mounted bodily upon a special chassis; in another the forward wheels of the en-

(Concluded on page 272.)

Fire engine in which both the propulsion and the pumping are done by a six-cylinder motor.



Water tower fitted with a four-wheeled tractor.

Hook and ladder drawn by a three-wheeled tractor.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Of Interest to Farmers.

MANURE SPREADER.—J. A. OLSON, Hildreth, Neb. The invention refers more particularly to the class comprising a pair of spreaders the distance between which is automatically varied by the material passing between the spreaders It provides a spreader in which the pressure produced on the spreaders by the material passing between them is automatically adjusted

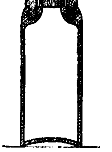
SWEEP STOCK PLOW.—H. T. YOUNG, Florence, S. C. This invention is for use for siding young corn and for the cultivation of cotton throughout its growth, wherein mechanism is provided for permitting the plow to be used toward and from the beam without dismantling the plow or removing the plow from the supporting hanger, and wherein the plow may be held in adjusted position firmly and without any attention from the operator, wherein the stock is supported from the beam, so that it may swing with the plow, and wherein the stock is connected to the plow to swing in unison therewith and to hold the same relative position with respect to the plow regardless of the position of the plow

PRESS—L MATTHEWS, Paris, Tenn. This invention is adapted for use in baling hay and like articles, wherein a pressing chamber is provided, and a plunger movable longitudinally of said chamber and having means of engaging the chamber for guiding the plunger, together with power operated mechanism for reciprocating the plunger.

Of General Interest.

RIBBON DEVICE.—W F. SPRICK, Stickney, S. D. This device is adapted to support and display a roll of ribbon or the like attractively and to so hold the ribbon that any desired amount may be readily unwound and removed without displacing the roll or rumpling or soiling the ribbon, and wherein means is provided for permitting ribbons of different widths to be handled

BOTTLE C V JOHNSON, Goldfield, Nev. This bottle cannot be opened after being sealed by a cover, without first breaking the cover, and the cover cannot be replaced without detection The cap or cover is designed to be fitted over the ordinary neck of a bottle and there is the necessary maximum amount of space within the cover and exterior of the bottle neck, for containing data concerning the filling of the bottle, or of other information concerning the goods therein



BOTTLE.

MEANS FOR CLEANING SEWERS—J. BRUCE, 3258 Thayer St, Pittsburgh, Pa. A small opening is cut in the sewer and the device is introduced through such opening and then rotated by means of a hand brace or other equivalent The device is constructed of steel wire, preferably in the form of a loop, and the free ends of the strands of wire are secured in a suitable clamp which is, in turn, attached to a hand-brace

COMBINED ASH CAN AND LAWN ROLLER.—J. C. B. JARVIS, 1514 76th St., Brooklyn, N Y This invention provides a can having a cover and provided with a sleeve supported by the bottom of the can and the cover for receiving an axle so that when the arms and the tongue are pivotally connected with the axle, the can may also be filled with ashes, and used as a roller for rolling the lawn, tennis courts, etc.

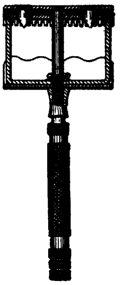
Hardware and Tools.

CAN OPENER.—L. E. HOLMES, Robbinston, Maine. This improvement relates to tools or implements for opening tin cans of fruit, vegetables or the like. Among the objects is to produce a tool of a simple and comparatively cheap construction which is not only easy and reliable of operation, but also which is not likely to damage the contents of the can or receptacle being acted upon.

DRILL BIT—A W. TAYLOR, 812 Rose St., Peckville, Pa. The design of this invention is to provide a drill that will readily cut through hard substances, and a drill that may be turned easily in the drill hole, and that will produce a straight smooth hole to properly receive the cartridge. The invention provides a plural bit, the elements of which may be readily removed and renewed.

SAFETY RAZOR.—L. KALINA, 132 Nassau St., New York, N. Y. The invention provides a safety razor to permit of conveniently assembling the parts for shaving purposes or disassembling the same for cleaning the parts and removal of the blade for stropping or other purposes, the razor being of such shape that when not in use for shaving purposes it can be readily used as a cuff button.

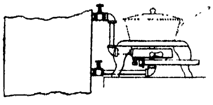
SAFETY RAZOR—S. KITZES, 630 Concord Ave., New York, N. Y. The object of the invention is the provision of a new and improved safety razor of the flexible blade type, arranged to permit of conveniently and quickly assembling and disassembling the parts, and to provide a detachable gathering receptacle for the lather The razor is composed of comparatively few parts, and when in use the lather readily passes into a receptacle which thus forms a shield for the hand holding the razor



SAFETY RAZOR.

Heating and Lighting.

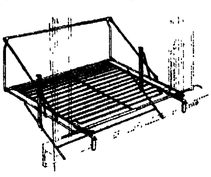
GAS BURNER AND WATER HEATER—J. A. FRISK, 702 W. Illinois St, Urbana, Ill This gas burner is adapted to act as a water heater, the structure shown herewith being characterised by an absence of means whereby the passage of air through the burner structure is prevented The invention provides a burner and heater, preferably of integral construction, the embodiment shown making provision for the utilization of heat below the burner openings as well as along the sides thereof



GAS BURNER AND WATER HEATER.

Household Utilities.

WINDOW CLEANING PLATFORM—H BOTTJER 681 Classon Ave, Brooklyn, N Y The invention relates to temporary platforms or scaffolds, and has particular reference to means for supporting an operator and cleansing materials in the cleaning of windows. He also provides a platform of the character indicated, which may be adjusted to fit any ordinary size of window, and which will be strong and reliable when used in any position of adjustment with respect to the size of the window.



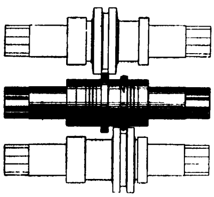
WINDOW CLEANING PLATFORM.

EXTENSION TABLE—V. F NEUMANN, Tivoli on Hudson, N Y This invention embodies a plurality of sections or leaves which, when not in use, can be pushed in or out of the way under the table top. An equal number of leaves are used at opposite ends of the table so that it can be lengthened at one or both ends, as desired. When the length of the table top is increased by the extensions, one or more of said extensions can be employed, so that the top of the table can be lengthened at either or both ends to a greater or less degree

CONVERTIBLE SOFA AND BED.—J. F. KAMPE, 240 67th St., Brooklyn, N. Y. The invention relates to furniture, and its object is to provide a new convertible bed and sofa, which is simple and durable in construction and arranged to permit of conveniently changing the sofa to a bed or *vice versa*. Comparatively few parts are required for accomplishing the desired movement of the back when folding the same to form the back for the sofa or when extending the same to form an outer section of the bed.

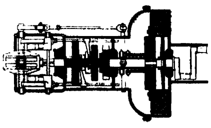
Machines and Mechanical Devices.

SHAPING ROLLS FOR HORSESHOE BARS.—L. T PAGE, Box 104, Wareham, Mass This invention provides means for mechanically creasing and partially punching the bars from which horseshoes are subsequently made, prevents the creeping or misregistering of the rolls with the bars and shoe forming sections thereof, reduces the friction offered by the bars to the rolls when passing therethrough, and provides rolls of the character mentioned, having a simplified and economical construction



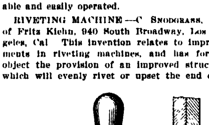
SHAPING ROLLS FOR HORSESHOE BARS

TRANSMISSION MECHANISM—A. B. BROCKMAN and W BROCKMAN, Lawrence, Neb This invention provides a mechanism of the finest possible parts, and of the simplest type, wherein a selective lever is provided for controlling both the clutch and the gear transmission mechanism, and wherein when the selective lever is in neutral position, the gear transmission mechanism is out of mesh, and when moved out of neutral position the selected gear is first fully engaged before the clutch is permitted to close, and wherein the gears are always positively locked with respect to the operating lever, which will be reliable, durable and easily operated.



TRANSMISSION MECHANISM.

RIVETING MACHINE—C SNODGRASS, care of Fritz Kiehn, 940 South Broadway, Los Angeles, Cal This invention relates to improvements in riveting machines, and has for an object the provision of an improved structure which will evenly rivet or upset the end of a bolt, rivet or other similar article with a minimum amount of noise Another object is to provide a rapidly rotating riveting head formed with rotating rollers acting as the contact members for performing the upsetting operation



RIVETING MACHINE.

EXHIBITING APPARATUS—A. P ROESSNER, care of Automatic Electric Sign Co, 814 Macdonough St, Brooklyn, N Y This apparatus is primarily designed for advertising purposes; and it comprises a construction which is automatically actuated and controlled so as to move a plurality of slides or negatives in succession into operative relation with respect to a projecting device by means of which the designs formed on the slides are thrown upon a screen, to be viewed

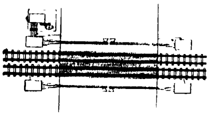
APPARATUS FOR DRYING ARTICLES FORMED FROM PLASTIC MASSES—O EBERHARD, Heidenau, near Dresden, Germany The drying of objects formed from plastic masses, particularly those containing a large proportion of water, is attended with difficulty because if the drying is not uniform strains may readily arise in the material and produce modification of form. By means of the novel drying device used in the present invention defects and difficulties are eliminated owing to the fact that during the drying operation the material under treatment is given a uniform displacement which produces a constant modification in the positions of several parts of the surface of the object relatively to the source of heat and thereby causes this source of heat to act uniformly on all sides

Prime Movers and Their Accessories.

INTERNAL COMBUSTION ROTARY ENGINE—C L RAGOT, 903 Clinton St Hoboken, N J The improvement refers to internal combustion rotary engines admitting of general use, and more particularly to a type of such engine which, because of its lightness, strength, smooth running reliability simplicity and various other qualities, enable it to be used in connection with flying machines

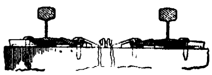
Railways and Their Accessories.

GATE OPERATING MECHANISM J E C JACOBSEN, 29 Fourth Ave, Nyack N Y, and C. A V, J SEGERSTEN, Nyack, N Y This invention comprehends mechanism whereby a train in approaching a predetermined part of a track provided with gates will cause the gate to close automatically, will actuate lamps serving as alarms, and will retain the gates closed and the alarm active so long as the train is present, but when the train departs, the gates are automatically opened and the alarm rendered inactive



GATE OPERATING MECHANISM.

TIE PLATE—W. M GLOTFELTY, Ohiopyle, Pa The present invention has reference to tie plates forming rail chairs and connections between track rails the inventor's object being to provide a tie plate particularly adapted for use with certain connections to prevent the rail from spreading and also constructed so as to receive and retain a tie preservative and prevent the rails from tilting or moving apart.



TIE PLATE.

Pertaining to Recreation.

ARTIFICIAL BAIT—C W STEWART, 120 N 3rd St, Olean, N Y This improved bait is provided with a covering having succeeding layers, each simulating a different fish either as to form or color or both and the layers are adapted to be successively removed to expose different representations in succession until the correct bait is found to successfully attract the fish under the particular conditions, as season and weather or the particular character of the fish being sought

Designs.

DESIGN FOR A SET OF CHARACTER-BLOCKS—DR W C BAKER care of Baker & Bennett Co, 643 Broadway New York, N Y This design is a view in elevation of a set of character blocks representing the complete alphabet and numerals in perspective The mechanical construction of the blocks is so perfect in design that it gives a surprising ornamental effect in each character

DESIGN FOR A SOIL PIPE FITTING D HELLER, Baltimore Md In this ornamental design for a soil pipe fitting the article is shown both in a side view and a longitudinal section view

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NOTE—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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No. 1—"How the Navy is Daily Employed"—by *Hon. Franklin D. Roosevelt, Asst. Secy. of the Navy.*
No. 2—"Sea Power and Our Foreign Policy."
No. 3—"The Decline of the United States Navy to Third-Class Rank."
No. 4—"The Price we Pay for Self-Sufficiency and Unpreparedness."

The 5th article appears in this issue

No. 5—"Battleship Strength Necessary to Guarantee Peace."
No. 6—"The Shortage of Scouts, Torpedos and Mines."
No. 7—"The Shortage of Officers and Men."
No. 8—"The Need of a System of Rapid Mobilization."
No. 9—"The Need of a Council of National Defense."

The 10th and concluding article will be written especially for this series by Hon. Josephus Daniels, Secretary of the Navy

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Modern Motor Fire Apparatus

(Concluded from page 270.)

gine are replaced by a three-wheeled tractor, and in still another the forward wheels have been replaced by what virtually amounts to a two-wheeled tractor, the engine standing well out in front and driving through a shaft and side chains.

The vehicle which utilizes but one engine for propulsion and pumping is being widely adopted because of its efficiency and the absence of necessity for carrying two kinds of fuel. All of these machines will run at great speed to a fire, after which a simple clutch serves to disengage the motor from the propelling machinery and engage it with the pump; there is no need to wait for steam and no lack of water pressure because of low steam; incidentally, the unit is generally self-contained in that it carries its own hose; it is independent of the hose wagon which may never reach the scene of the fire because of some accident.

The motorizing of ladder vehicles suggests other problems because of the great length of the equipment. Tractors have been pushed into the breach, so to speak, and have made easy the solution of a problem that might have proved troublesome. At the same time their use permits existing apparatus to be kept in service, for in the majority of cases it is a simple matter to remove the front wheels and substitute the tractor. One of our illustrations shows a water tower with a four-wheeled tractor.

It has been a hard fight to have motor fire apparatus adopted and the antiquated horse-drawn apparatus relegated to the background. But it has been a winning fight from the beginning.

Motor Truck in Snowbound Streets —A Correction

IN an article on "The Motor Truck in Snowbound Streets," published in the SCIENTIFIC AMERICAN of February 28th last, the following statement was made concerning a motor coal truck:

"Altogether during the three days of the storm it ran about 5,000 miles and used up over 60 feet of tire chains. . . ." It is hardly necessary for us to say that the statement is incorrect. It should have read "The truck was a stock machine that had run altogether about 5,000 miles. During the three days of the storm it used up over 60 feet of tire chains," etc.

Lifeboat Test Off Sandy Hook

(Concluded from page 262.)

was damaged in collision with an Atlantic liner in New York harbor. The colliding ship evidently crowded the lifeboat against a hatch, and produced the long straight indentation shown in the photograph This boat was put overboard and towed over a long distance to a yard for repairs, and yet showed no leaks whatever. In spite of this deep indentation the boat would have carried its passengers in an emergency. In tests carried out on the United States Army transport "Kilpatrick," a Lundin steel boat, when half lowered, was pulled away from the ship and allowed to swing back heavily against her hull, with no resulting damage to the boat.

At the conclusion of the tests the three boats were towed from a point several miles outside of Sandy Hook to the Battery at a speed of 13 knots. The first part of the trip was made through rough water, and in spite of this rather brutal treatment, the high rounded bows of the boats carried them comfortably over the seas, and everything was sound and tight when the Battery was reached. The violence of the test is shown in our photograph, taken from the deck of the third ship.

In designing the power lifeboat the broad principle was laid down that all lifeboats, whether with or without power, should always be of such size and construction that they can readily be launched fully loaded, and pushed off the side of the ship as soon as possible after being water-borne. With this in view, the power boat is built with a tunnel by which the propeller and shaft are protected

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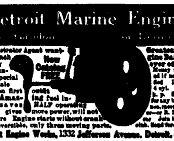

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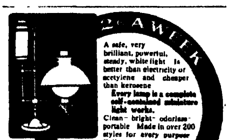

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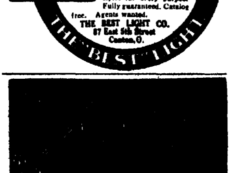

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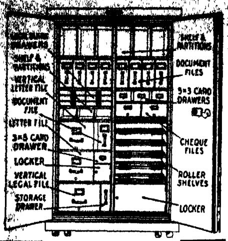

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against any damage while the boat is being launched; and the strength afforded by the double bottom is such that the boat can be lowered when loaded to its maximum capacity of seventy-five people.

How the Kinematograph Facilitates the Study of Tissue

(Concluded from page 269.)

difficulty was the impossibility of following the entire process of the blood-circulation in a single specimen of the artificially developed blastoderm. And it was as a means of getting around this very great obstacle to thorough observation that the kinematograph was employed.

The moving picture catches and reproduces alike the exceedingly slow movements of early tissue growth and cell division, and the subsequent rapid changes connected with the heart and blood vessels, neither of which can be followed satisfactorily in detail through the microscope or by the use of ordinary photography

By the use of the kinematograph, it is possible also to study the primary divisions of the brain, and various other questions---such, for example, as the reason for the invariable position of the heart on the left side of the body; the significance of which knowledge is apparent only to the embryologist.

The device first used in photomicrography, i. e., a camera fastened to a slotted plate braced by an iron framework screwed to the floor (the camera being connected with the microscope) was but slightly modified on the adaptation of the kinematograph to it. "First, a replacement of the lens by a metal tube, second, the substitution of a pulley and interlocking gear-wheels for the ordinary hand-cranking device The gear wheels, two in number, are of different sizes. The larger is screwed fast to the shafting that operates the mechanism within the camera, while the smaller, to which is riveted a small pulley, engages the larger wheel at one side. This reducing gear is so arranged that one revolution of the pulley gives one revolution of the rotary shutter within the camera, the equivalent of one picture."[*]

George Westinghouse

(Concluded from page 267.)

sure was he of himself that he undertook to design the couplers, although there was no time for elaborate tests. The invention was a success from the very first in actual practice.

Fully as important from an economical standpoint as the invention of the airbrake is the introduction of the alternating current, with which Westinghouse's name must also be conspicuously associated as a promoter and engineer. He heard of the experiments made in Europe with alternating currents; his broad mind immediately saw the possibilities of high tensions; forthwith he began experiments in this country That so much progress has been made in this country in high tension transmission is due almost entirely to Westinghouse's initiative. Cities situated within two or three hundred miles of a hydro-electric power plant might not be electrically lighted now had it not been for Westinghouse's farsight.

The introduction of the alternating current was marked by a bitter struggle. Influential as he was, heralded the world over as a great inventor and a great engineer, he found it just as hard to overcome opposition to the alternating current as to induce timid railway officials to adopt the airbrake.

There was more than mere ignorance behind the opposition. Vested interests had to be fought—interests which seem actually to have conspired to prevent the employment of a system which has proved itself of world-wide benefit. For fifteen year the attack continued. Even Edison thought it unwise to encourage the use of the alternating current.

The struggle came to a crisis during the

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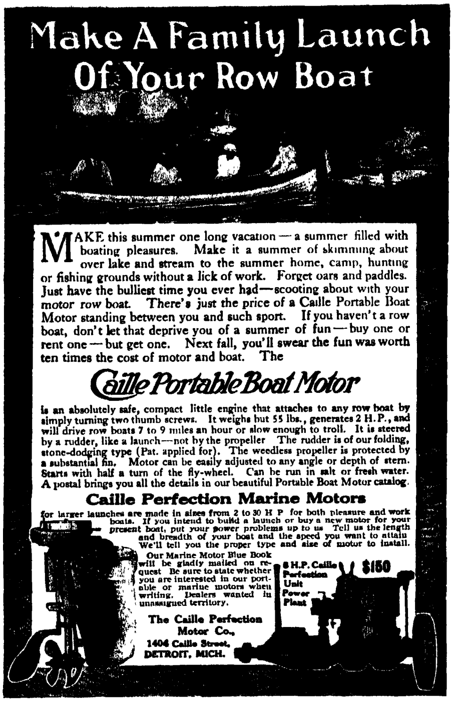
[*] *Journal of the Am. Med. Assn.*, Aug. 9th, 1913.



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World's Fair of 1893 at Chicago. Westinghouse contracted to light the Fair at a price one million dollars less than the nearest bidder. His opponents induced the exposition authorities to exact a bond for the fulfillment of his obligations, believing that no one would become surety for a bond which might be forfeited because it guaranteed the performance of something which had not been attempted in electrical engineering up to that time. Westinghouse promptly furnished three bonds. Next the patent laws were invoked to deter him He was accused of infringing existing patents which covered methods of making incandescent lamps. He merely sat down and invented processes and devices of his own which were obviously not infringements. The Chicago Fair made money; but it made it thanks to Westinghouse The stockholders divided one million dollars among themselves – the exact amount saved by the adoption of the Westinghouse alternating current system

After the success at Chicago, Westinghouse boldly set to work at designing the giant alternators of Niagara. There are ten of them. To this day they are regarded as monuments in contemporary electrical engineering In 1912, by the irony of fate, the Edison gold medal was awarded to him at a banquet of the American Institute of Electrical Engineers for his "meritorious achievement in connection with the development of the alternating current system for light and power." Among those who witnessed that event were engineers who had decried the alternating current as a force that could not be controlled, as a form of energy that should not be used because it might kill.

Two inventions, in the development of which Westinghouse played a prominent part, are the Melville-Macalpine-Westinghouse geared turbine for steamships and the automobile airspring Both inventions have been so fully described in these columns that it is hardly necessary to comment upon them at length again. Interesting, too, is a way of his for controlling the operations of a ship's engines by a device placed on the navigating bridge of the vessel The movement of a lever on the bridge starts or stops the engines, reverses them, and regulates the speed. By its use the engines of the United States steamship "Neptune," a collier, have been reversed from full speed ahead to full speed astern in twelve seconds.

Breadth of vision and receptivity were characteristics of Westinghouse Most inventors can see good only in their own creations Despite all their sufferings and trials they do not often extend a helping hand to fellow inventors Westinghouse was an inventor of a totally different stamp. Not only was he a great inventor himself, but he did more than any other inventor of his time to develop the inventions of others He grasped a new idea with flash-like rapidity Tesla, Nernst, Cooper-Hewitt, Stillwell, Lamme, and a dozen other less important succeeded very largely because of the interest that he took in their labors He spent fortunes in research designed to aid them.

Westinghouse was essentially what the world calls a practical man He could work with his hands as well as with his head. He had learned the use of tools in his boyhood; in his youth he had familiarized himself with every resource of the machine shop, and during the years of his manhood he worked on in the same way as if his livelihood depended on the manual exercise of his mechanical skill. Hence he was a type of employer that men must respect; they felt that he could handle their machines as well as they themselves

It is practically impossible to present a complete view of his economic importance. Perhaps some idea of the vastness of the industries which he created may be gleaned when it is said that there are now thirty-five Westinghouse companies in Europe and America, that they employ 50,000 persons, and that they operate with a total capital of $200,000,000. He himself took out patents on about three hundred inventions, but he controlled as many as 15,000 patents

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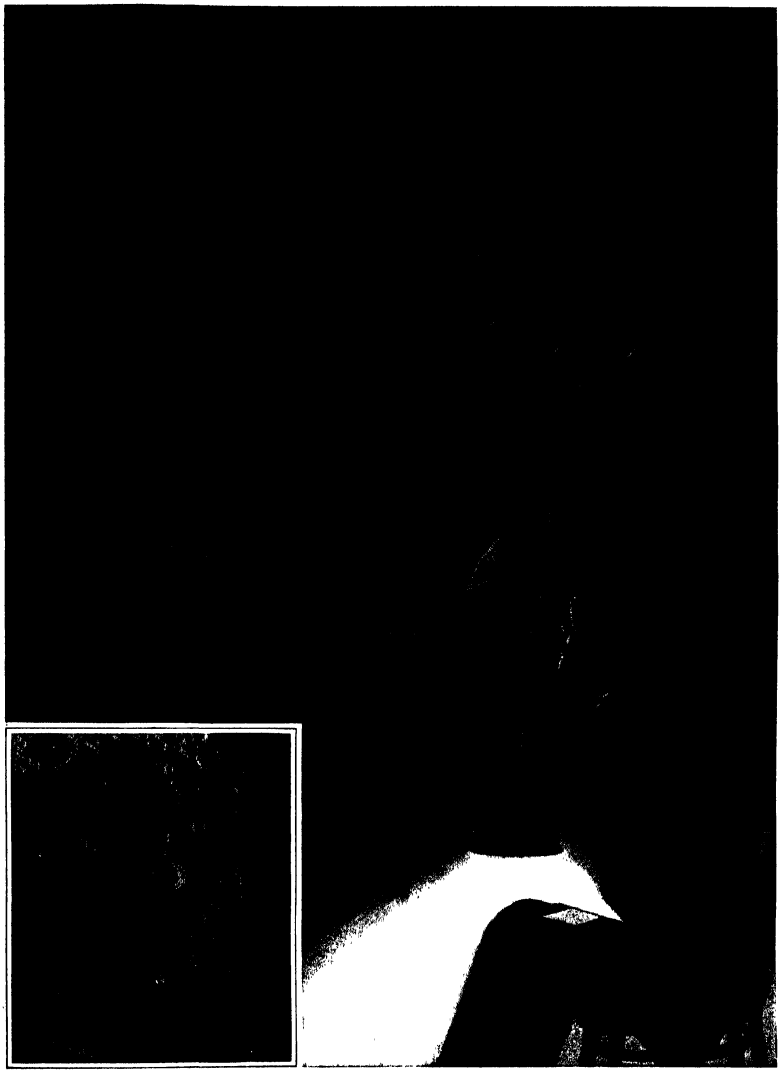

Vol. CX. No. 14
April 4, 1914

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SERVICE KEEPS YOUR TRUCKS ON THE JOB

Packard service is based on our knowledge that mechanical delay means unnecessary expense to the truck owner.

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Packard service means more than keeping repair parts in stock. Every Packard part is ready for quick installation. It is standardized: no filing, no machining, no tinkering. Where a fleet of Packards is in service, the parts are interchangeable in case of need.

The Packard dealer's thorough inspection and written reports insure continuous operation at minimum cost. Our technical men are always ready to give your driver expert assistance.

In short, Packard service makes your transportation schedule a known quantity.

Every time you see a Packard truck, remember Packard service stands ready to keep that truck operating every minute of every working day. Packard service is a part of the truck, a part of your original investment. That is one reason why Packard trucks are predominant in 181 lines of trade.

The Loose-Wiles Biscuit Company, after using Packard trucks for three years, have placed their tenth repeat order which calls for 24 two-ton and three-ton units.

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So it was that in the development of an efficient starting and lighting equipment for automobiles the production of a thoroughly efficient ignition was the logical and necessary first step.

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Delco ignition was of a new and distinctive type. It was contrary to established practice. Naturally it met with opposition and criticism.

But it made good.

It made good during those first few years when it was only an ignition system.

It has even more emphatically demonstrated its efficiency during the last three years as an important part of the Delco system of Electric Cranking, Lighting and Ignition.

And finally—the correctness of the principle upon which it is based has come to be so generally recognized that it is being adopted as fully as patent restrictions will permit by many of the most prominent electrical and automobile engineers in the world.

Delco ignition is simply one factor in the success of the Delco system.

It has shown such high efficiency, however, that not a single automobile manufacturer who has once adopted it has been satisfied to go back to the older types of ignition.

It is not as spectacular in its performances as the cranking or even the lighting, but in its quiet, effective way it has played an important part in the revolutionizing of the automobile industry.

You will find the Delco system of cranking, lighting and ignition today on more than 90,000 motor cars and this number is being added to at the rate of over 8,000 a month.

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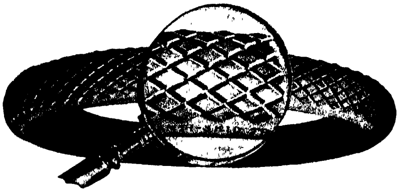

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They are the only tires which are final-cured on air bags shaped like inner tubes. This is done to save the countless blow-outs due to wrinkled fabric. This extra process adds to our tire cost $1,500 daily—an extra cost which no other maker pays.

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They are the only tires made in a satisfactory way so that they can't be rim-cut.

They are the only tires which carry our double-thick All-Weather-Tread.

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No-Rim-Cut tires, on the average, give the limit of possible mileage. We say this after years of research and experiment, which have cost us $100,000 per year.

Our experts in these years have made thousands of attempts to build tires that give more mileage. They have tested the new tires against the old in every way they know. And they say that Goodyear tires as made today mark the mileage limit.

Where We Save

We save by mammoth output, by efficiency and by modest profits. Our profit last year averaged 6½ per cent. It is thus we give you tires like these at present Goodyear prices.

Men have bought, in the past two years, more than two million of them. Bought them because mileage records had proved them the best tires built.

It is easy to build tires worth less than Goodyears but men can't build a tire worth more.

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1914

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A canvass among New York repair shops showed that about one-half of the automobile engine troubles are caused by incorrect lubrication.

Correct automobile lubrication is an intricate, scientific problem.

Motors and feed systems differ widely. *No one lubricating oil can be efficient for all cars.*

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You selected a car that suits you. Now select an oil that suits your car.

Your motor has approximately 1500 parts. To reach all friction points properly your oil must suit *your* motor.

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Throughout the world, the counsel of the Vacuum Oil Company on lubricating problems relating to every class of machinery is sought by engineers who must meet the most rigid efficiency standards

Lubrication with us is both a business and a profession.

The Lubricating Chart, printed in part on the right, represents our professional advice on automobile lubrication. It is a result of the most far-reaching and thorough study of automobile lubrication that has ever been made.

It was prepared after a careful analysis of the motor of each make and model of American and foreign car.

The oils specified have been thoroughly proven by practical demonstration.

For a number of years this Chart, which is annually brought up to date, has been the standard guide to correct automobile lubrication

Make a note of the grade specified for your car Then make sure that you get it.

It is safest to buy in original barrels, half-barrels and sealed five and one-gallon cans. See that the red Gargoyle, our mark of manufacture, is on the container.

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Gargoyle Mobiloil "B,"
Gargoyle Mobiloil "E,"
Gargoyle Mobiloil "Arctic."

They can be secured from reliable garages, automobile supply houses, hardware stores, and others who supply lubricants.

For information kindly address any inquiry to our nearest office.

Correct Lubrication

Explanation: In the schedule, the letter opposite the car indicates the grade of Gargoyle Mobiloil that should be used. For example, "A" means "Gargoyle Mobiloil A." "Arc" means "Gargoyle Mobiloil Arctic." For all electric vehicles use Gargoyle Mobiloil "A" The recommendations cover both pleasure and commercial vehicles unless otherwise noted.

MODEL OF	1910		1911		1912		1913		1914	
CARS	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Abbott Detroit	A	Arc.	A	Arc.	A	Arc.	A	[illegible]	[illegible]	Arc.
Alco	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.		
American	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Autocar (2 cyl.)	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" (4 cyl.)	A	E	A	Arc.	A	Arc.				
Avery	A	E	A	E	A	A	A	A	A	A
Buick (2 cyl.)	A	A	A	A	A	A	A	A		
" (4 cyl.)	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Cadillac (4 cyl.)	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Cartercar	A	E	A	E	A	E	A	E	Arc.	Arc.
" Com'l.	A	E	A	Arc.	A	Arc.	A	Arc.		
Case			A	A	A	Arc.	A	Arc.	A	Arc.
Chalmers	Arc.	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.	A	A
Chase	B	B	B	B	B	B	B	B	B	B
Cole	Arc.	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Delaunay Belleville	B	A	B	A	B	A	B	A	B	A
E M F	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.				
Fiat	A	A	B	A	A	A	B	A	B	A
Flanders	E	E	E	E	Arc.	Arc.				
" (6 cyl.)							Arc.	Arc.		
Ford	A	Arc.	E	E	E	E	E	E	E	E
Franklin	B	Arc.	A	Arc.	A	Arc.	A	[illegible]	A	A
" Com'l.	B	A	B	A	A	Arc.	A	[illegible]	A	A
G M C					Arc.	Arc.	A	[illegible]	A	Arc.
Havers 6-44			A	Arc.	A	Arc.	A	[illegible]	A	A
Havers 6-30								[illegible]	A	A
Haynes	A	E	A	Arc.	A	Arc.	A	[illegible]	A	Arc.
Hudson	Arc.	Arc.	A	Arc.	A	Arc.	A	[illegible]	A	Arc.
Hupmobile "20"	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	[illegible]	A	Arc.
" "32"							A	[illegible]	A	Arc.
I H C (air)							A	A	B	A
" (water)							A	A	A	A
International	B	A	B	B	B	A				
Interstate	A	E	A	Arc.	A	Arc.	A	Arc.		
Jackson (2 cyl.)	A	A								
" (4 cyl.)	A	Arc.	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
Jeffery									A	A
Kelly			Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	A
King			A	E	A	B	A	B	A	A
Kissel Kar	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
Knox	B	A	B	A	B	A	B	A	B	A
Krit	A	A	A	A	A	A	A	A	A	A
Locomobile	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Lozier	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
Mack	A	E	A	E	E	E	E	E	A	A
Mack, Jr									A	Arc.
Marion	A	E	A	E	A	Arc.	A	Arc.		
Marmon	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Maxwell (2 cyl.)	E	E	E	E	E	E				
" (4 cyl.)	E	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" (6 cyl.)							Arc.	Arc.	Arc.	Arc.
Mercer	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Mitchell	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Moline	A	E	A	Arc.	A	Arc.	A	Arc.		
Moline Knight									A	A
Moon (4 cyl.)	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
Moon (6 cyl.)									Arc.	Arc.
National	A	A	A	A	A	A	A	A	A	A
Oakland	A	E	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
Oldsmobile	A	E	A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
Overland	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Packard	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
Paige Detroit	E	E	A	Arc.	A	E	A	E	A	A
Pathfinder							A	Arc.	Arc.	Arc.
Peerless	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Pierce Arrow	Arc.	Arc.	A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
" " Com'l.			Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Pope Hartford	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Premier	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Rambler	A	A	A	Arc.	Arc.	Arc.	Arc.	Arc.	[illegible]	[illegible]
Regal	A	E	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Renault	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Reo	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
S.G.V.			B	Arc.	B	Arc.	B	Arc.	A	Arc.
Selden	A	E	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Simplex	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Speedwell	Arc.	Arc.	A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
" "Mead"							A	Arc.	B	[illegible]
Stearns	Arc.	Arc.	A	Arc.	A	Arc.				
" "Knight"					A	A	A	A	A	A
Stevens Duryea	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Stoddard-Dayton	Arc.	Arc.	A	A	A	A	A	A		
" "Knight"					A	A	A	A		
Studebaker	E	E	A	Arc.	Arc.	Arc.	A	Arc.	A	Arc.
Stutz					A	A	A	A	A	A
Velie 4-40	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Velie 5-30									[illegible]	Arc.
Walter	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
White (Gas)	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Winton	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.

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VOLUME CX. NUMBER 14.]

NEW YORK, APRIL 4, 1914.

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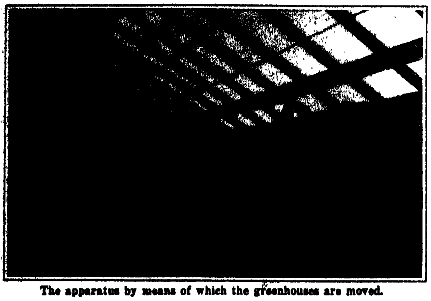
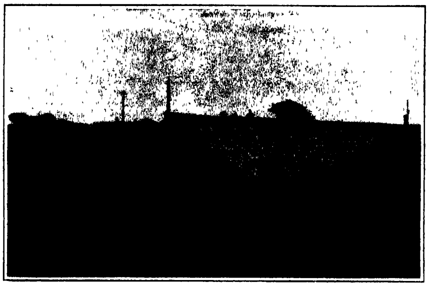


The apparatus by means of which the greenhouses are moved.



Movable greenhouse and the hand-wheel with which it is propelled.

Traveling Greenhouses

By S. Leonard Bastin

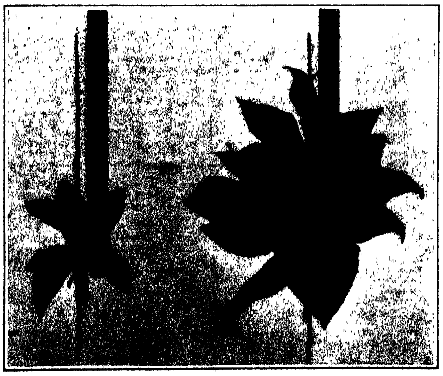
A VERY interesting development in the horticultural world has been the coming of the movable glass-house. In almost all temperate regions, there are occasions when crops of many kinds benefit enormously if a temporary protection of some kind can be given to them. Mr. J. Pullen-Burry of Sompting, near Worthing, England, has at last solved the difficulty by the introduction of his traveling greenhouse, which can be conveyed from different points of the ground to the situation where it will be most useful

During the last few years there have been many efforts to establish the culture of the tobacco plant in Great Britain and Ireland. The variable nature of the climate of the United Kingdom has very much hampered these undertakings. In particular, it may be mentioned that during the last fortnight of its growth the tobacco plants have suffered very much from the effects of low temperature. The foliage has failed to ripen properly, with the result that often enough, a most promising crop has finally turned out to be almost a failure. Some kind of protection is also to be desired in the early summer. Between these two periods the tobacco plant is quite at home in almost any part of England or Ireland. There is no need, and it would of course be very expensive, to have the tobacco crops under glass the whole time. It is just here that the traveling greenhouses are so useful. These are moved over the crops of tobacco at critical times, and for the remaining parts of the season they are used in connection with different crops altogether.

A glance at the accompanying photographs will show the nature of the movable glass-house. A typical house is 100 feet in length, and 14 feet in width. It is fully equipped with a boiler and heating apparatus. Although the structure is estimated to weigh about twenty tons, it can be readily controlled by one man. By simply turning a handle the wheels travel along a concrete way, from which they are prevented from slipping off by a guard rail. The heating apparatus of course goes with the house, and experiments have shown that the whole business of transfer does not take more than about twenty minutes. The question of cost, which is of course a matter of importance, has been carefully worked out, and it is demonstrated that a movable hothouse does not involve more than 20 per cent increase in the expenditure which would be incurred for the ordinary type.

The importance to the horticultural world of this new invention can hardly be overestimated. Many kinds of market-garden crops only require protection during the first stages of their growth. If this can be provided there will be a very much earlier gathering. Yet the actual time which they need spend under glass would only be about two or three weeks Hence it is not always worth while planting them in a greenhouse. Under the movable greenhouse system the crops can be given just as much protection as is necessary, and afterward the glass-house is employed for something else. Thus an enormous saving is effected in all ways.

Movable boiler from which the hot water supply is secured.



Grown in the open. Grown under glass

How the tobacco plant thrives under the movable greenhouse.

Softening Souple Silk

RAW silk is of three kinds, known to the trade as organzine, tram, and souple. The organzine is used for the warp of woven materials, and the tram for the weft Before these are dyed and prepared for weaving, the silkworm gum must be washed out by a process called "stripping" The souple silk is used for the manufacture of the soft fabrics, such as messaline, chiffon, etc., and in order that these materials may retain their softness and pliability and admit of being crushed in the hand without showing any signs of creasing, the souple silk must first undergo a process known as softening.

This process is a very delicate operation, and the quality of the silk depends very much upon the care with which the softening is done In this case the silk is not stripped of the silkworm gum, but is immediately placed in a bath of pure olive oil soap. This bath is made up of about fifty parts of pure water to one of strong liquid soap. The silk is suspended in this bath on wooden rods, and is moved back and forth by two operatives who frequently turn it and keep it in constant motion The bath is heated to 30 deg R., and owing to the continuous agitation of the silk in the bath, the silkworm gum, while not washed out, is made to permeate uniformly throughout the silk

After being treated in this manner for about an hour the silk is removed and placed in another bath of lukewarm water where it is again treated in the same way. This process continues for about fifteen minutes, and is intended only to cleanse the silk The skeins are then removed from this bath and placed in another consisting of about sixty parts of pure water to one of concentrated sulphuric acid heated to 60 deg R Here it is worked back and forth, and frequently turned very slowly for about two hours, or until it yields very readily to a pressure of the finger It is then removed and given two thorough washings in cold water It is then ready for the dyeing.

One of the Largest Forest Nurseries in the United States is conducted by the forest service near Haugen, Montana It is known as the Savenac nursery, and has a capacity of four million young trees a year.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Redemption of Mesopotamia

THERE is a romantic as well as an historical interest attaching to the great irrigation works which are being carried on in ancient Mesopotamia with the object of restoring to that historic and richly fabled country something of its one-time fertility. Like much of the land in what was once known as the great American desert, the soil and climate of the valley of the Euphrates are such that if water is supplied, it shows a wonderful productiveness. In earlier times the inhabitants planned and built a system of dams and canals, the remains of which show no little engineering skill; and it is only because of abuse and neglect that the dams have broken down, the canals have silted up, and this once productive land has been transformed into noisome swampland or arid desert

The Turkish government, prompted no doubt by the excellent results which have been achieved in the valley of the Nile, in 1909 authorized Sir William Willcocks to visit Mesopotamia and report upon the feasibility of constructing a new system of irrigation works. In a report published in the following year, Sir William proposed an elaborate scheme of dams, canals, and other accessory works, the total cost of which was estimated at $75,000,000 The Turkish government decided to carry through the scheme in sections, and it authorized the immediate construction of a dam across the Euphrates at such a point as would serve to divert a supply of water to an ancient canal known as the Hilla Channel, which formerly supplied water for the irrigation of a large tract of land extending almost to the ruins of the ancient city of Babylon.

The ancient work consisted of a dam across the Euphrates which raised the level of the river sufficiently to pass the desired amount of water down the old Hilla Branch channel. The work had so far gone to ruin that the Hilla Branch had silted up and the country which it formerly served so well had reverted to the desert condition. It is interesting to note that the site chosen for the new dam is an endorsement of the wisdom of the early engineers; for the new structure is only about 2,500 feet upstream from the old structure. The difficulties of construction were increased by the lack of transportation and the absence of fuel Nevertheless, in less than three years' time, the original channel of the river was closed by a dam, a barrage seven hundred and eight feet in length provided with the necessary regulating gates was constructed, the Euphrates was diverted from its old channel and made to flow through the barrage, and a new diversion was cut from the Euphrates above the barrage to a connection with the old Hilla Branch. The barrage has thirty-six openings each sixteen and one half feet in width. The piers are built of brickwork and the openings are provided with the usual Stoney sluices At one side of the barrage is a lock 26 feet 3 inches wide, and 320 feet long, provided with a pair of gates in the center which divides it into two parts After the barrage was completed, the ground above and below it was excavated, the new channel for the river, 815 feet wide, was formed, and the river was made to pass through the barrage by way of this channel According to *The Engineer*, to which we are indebted for the above facts, there has been built, also, what is known as the Habbania Escape, by which the waters of the Euphrates, when the river is in flood, may be diverted partly into a lake and partly into a large natural depression in the ground. This will serve to prevent, or at least mitigate, the inundations which in times of flood have converted large sections of the adjacent country into morasses.

New York's Sewage Problem

TWO of the most important problems directly affecting the health of a great city—some will be prepared to say that they are absolutely the most important—are those of the provision of an abundant supply of drinking water and of the proper disposal of the sewage. At a cost of nearly $180,000,000, New York city has solved the first problem by a remarkably fine system of works by which an entirely new supply of 500,000,000 gallons of pure mountain water will be brought daily from the Catskill Mountains and distributed throughout the city With respect to this water supply, New York can be said to be fully abreast of the latest practice.

But when we come to the question of sewage disposal, the situation is simply appalling; for day by day this city is discharging into the waters with which it is surrounded, every gallon of the liquid refuse that it daily produces. This has been done under the mistaken belief that since the waters of New York harbor are subject to tidal flow, the sewage is diluted, carried away and lost in the broad Atlantic. As a matter of fact, nothing of the kind occurs On the contrary, the solids, held for a while in suspension, are carried to and fro with the ebb and flow of the tide and are finally deposited in an ever accumulating mass of filth covering the bottom of the harbor; and a very large proportion of it is deposited closely adjacent to the shore line and between the steamship piers

Hence it follows that the investigation which has been carried out by the Metropolitan Sewerage Commission is one of the most important affecting the public health that has taken place in all the history of New York. This commission recently submitted a statement to the mayor, in which it was said that New York city is thirty years behind the times in the matter of sewerage and sewage disposal. Accompanying this statement was one by X H. Goodnough, the engineer of the Massachusetts State Board of Health; and from these documents we learn that whereas the sewage of New York is discharged into the harbor without system or regulation, with results which produce serious injury to the public health and welfare, Boston and the harbor are protected from pollution by main drainage works which serve not only that city, but also a large number of cities and towns in its vicinity.

The Boston situation is capable of furnishing an instructive object lesson to New York city, for up to a certain point the experience of the two cities has been remarkably alike The conditions which led to the construction of the Boston works were like those which exist at the present time in New York. The sewage caused odors and sludge deposits, and, although it was impossible to trace individual cases of disease to the polluted water, physicians declared that no fact was better established than that foul air was unfavorable to health, and that extended changes in the sewerage system could alone accomplish practical good. The sewage disposal works of Boston consist of three ocean outlets to which the sewage, to the extent of about 200 million gallons per day, is taken for screening and settlement and ultimate discharge.

The members of the Metropolitan Sewerage Commission have visited the Boston harbor, and the commission's floating laboratory which was sent there made over one hundred analyses of the water. The water, except in the immediate vicinity of the three outfalls, was of excellent quality. Whereas the average amount of oxygen found in Boston harbor was generally over 90 per cent, it has often fallen below 20 per cent in New York harbor. Comment on this comparison as showing the harmful conditions at New York is unnecessary.

Contracted Computations—Dogma or Scientific Efficiency?

SCIENCE as taught at college is not free from the *dogmatic element, and the man who has the college gates well behind him* is apt still to trail after him a certain amount of more or less age-worn dogma. Indeed, it sometimes requires a certain temerity to attack precepts to which weight and dignity is added by good authority—this perhaps is one reason why so little question has ever been raised with regard to the propriety of the teaching: "Carry every computation only just to so many significant figures as the accuracy of the data warrants Anything beyond this," says the teacher, "is waste of time and energy, and gives a spurious appearance of precision."

This looks very plausible at first sight, but the teacher seems to have overlooked the fact that a certain amount—sometimes a considerable amount—of energy must be spent in determining just how many figures must be retained, at a minimum, in order to obtain the result with that degree of precision which the data permit. We quote from a book review in *Nature*:

> "We venture to question whether teachers do well in this matter. It is customary to work to a significant figure more than will be required in the result; this generally gives the result to the required approximation, but not always. Are we to chance the accuracy, or are we to complicate the process further by an estimate of the trustworthiness of the result? Moreover, the estimation of the number of figures to be retained, even in the normal case, is a matter of no little [illegible]; we have frequently known professors and schoolmasters of good standing to be at fault.
>
> "There appears to be no educational principle at stake, and the question is simply whether contracted methods conduce to speed and accuracy or not. Does the shortness of the contracted calculation compensate for the time spent in deciding how far to contract, and for the chance of error by excessive contraction? For the expert calculator, like the teacher of arithmetic or the observatory computer, it compensates without doubt For ourselves, and we imagine for most people (adults and children), contracted methods in their strict form do not compensate. For us the best way is to calculate stolidly through, and at the end throw away the unnecessary figures, or if the numbers get very heavy, to contract to a modified extent, keeping, perhaps, two or three more figures than a strict contractionist would allow."

Perhaps in this as in most other practical matters, no hard and fast lines can be laid down, and much must be left to the judgment of the individual.

Solar Radiation Measurements at Great Altitudes

THE problem of eliminating the effect of absorption by the earth's atmosphere in determinations of the solar constant of radiation has never been solved in an entirely satisfactory manner. The ideal solution would be to expose the measuring apparatus above the utmost limit of the atmosphere, and, although this is impossible, an approximation thereto consists in *sending up a pyrheliometer attached to a balloon* to the greatest height attainable. The first attempts to carry out such a plan were made last summer by the Smithsonian Institution, in co-operation with the United States Weather Bureau. A modified form of the silver-disk pyrheliometer was used. As it could not be kept pointed at the sun, the disk was placed horizontally, and the thermometer was contrived to record its temperature by photography on a moving drum. The disk was alternately exposed to the sun and shaded by the action of a shutter, moved by clockwork. Although in five ascents, on successive days, altitudes up to 20½ miles were attained, the freezing of the mercury in the thermometer unfortunately prevented records from being made above about eight miles. Mr. C. G. Abbot, under whose direction these observations were made, states that "all the measurements unite in indicating values of the solar radiation at altitudes of 10,000 meters (6.2 miles) and higher which fall below the value of the solar constant of radiation as obtained by other methods;" a very interesting result, despite the fact that this method is somewhat rough as compared with pyrheliometric measurements at the earth's surface. This year it is proposed to repeat the experiment with improved apparatus, which will include, *inter alia*, an electrical heating device to prevent the mercury in the thermometer from freezing. Mr. Abbot hopes to reach altitudes up to 40,000 meters (nearly 25 miles), at which the atmosphere is so exceedingly tenuous that the observations, if successful, should indicate very nearly the true value of the solar constant.

Defining the Cyclecar

THE fog that has obscured the exact meaning of the word *cyclecar*, as applied to that type of vehicle which is neither motorcycle nor full-sized automobile, is in a fair way to being dissipated. Ever since the cyclecar first appeared, the question of its proper classification with regard to other vehicles has been a moot one. Now, however, the Cyclecar Manufacturers' Association, but recently formed and representative of the majority of American manufacturers, has set its stamp of approval upon a specific definition; places vehicles other than full sized automobiles and motorcycles in three distinct classes, the first class including cyclecars, the second class slightly larger vehicles which are arbitrarily styled light cars, and the third class still larger vehicles which are to be known as small cars. According to the definition, a cyclecar is a vehicle having one engine of not more than 70 cubic inches piston displacement, the vehicle to weigh less than 750 pounds. A light car is described as a vehicle having one engine of from 70 to 100 cubic inches piston displacement and weighing between 750 and 950 pounds; and a small car is a vehicle having an engine with between 100 and 175 cubic inches piston displacement and weighing between 950 and 1,150 pounds. There are no other restrictions or limitations. Doubtless, the definition of these vehicles, which all heretofore have gone under the generic term cyclecar, will serve at least to slow the flood of inquiries with which the automobile industry and all connected with it have been inundated.

Science

Automatic Pianos have been installed on the restaurant cars of one of the principal railways in Argentina.

Exploration of the Brahmaputra.—According to the *Scottish Geographical Magazine*, Captains Bailey and Morshead have returned to India after an arduous journey in the dangerous country of the Abors, and announce that they have conclusively proved the Tsangpo and the Brahmaputra to be one river, thus settling one of the most interesting of geographical questions. At the same time they bring the surprising news that the supposed falls of the Tsangpo do not exist.

The Sootfall of Pittsburgh, as determined from careful measurements during the past year, ranges from 595 to 1,950 tons per square mile per annum. The destructive possibilities of this immense deposit may be illustrated by stating that if an equal amount of lampblack were ground with oil so as to form black paint it would cover from 17 to 57 square miles with two coats. Statistics of sootfall at certain places in Great Britain are as follows: Industrial section of Leeds, 529 tons; center of London, 426 tons; Glasgow, 820 tons.

Upper-Air Observations in India.—At the instance of the Royal Society, the meteorological service of India is about to embark on a campaign of investigations of the upper air which is expected to extend over a period of ten years. The headquarters of this work will be at Agra, where sounding-balloons carrying registering apparatus will be sent up about twice a week to the greatest heights attainable. There will probably also be four or five sub-stations, from which similar balloons will be sent up to moderate heights; say about 12,000 feet.

Scientific Balloon Ascents by human beings have, to a large extent, been rendered superfluous by the invention of automatic devices for registering the temperature, pressure, etc., at great altitudes; nevertheless, there are still many kinds of scientific observations in the upper air for which a personal observer is essential. A notable series of 16 manned-balloon ascents for the investigation of a wide range of problems has recently been executed at Halle, Germany, some of them to great altitudes (30,922 feet in one case). In one of these ascents, radio-telegraphic apparatus was carried in the balloon, and studies were made of the audibility of wireless signals at different altitudes. In others, specimens of air were collected for analysis up to 29,850 feet; the physiological effects of great altitudes were investigated; and measurements of electrical potential gradient and conductivity of the air were made up to 27,887 feet—an altitude greater than that at which any measurements of atmospheric electricity have ever before been made.

The Kara Sea Route to Siberia was the subject of an address delivered by Dr. Fridtjof Nansen before the Imperial Russian Geographical Society on his return to Europe, after making a journey to the Yenisei on the steamship "Correct." The speaker urged the Russian government to establish a wireless station at Dickson Harbor, at the mouth of the Yenisei, in addition to the three that have been established at the entrances to the Kara Sea. He also recommended that a small fleet of sailing vessels with auxiliary motors maintain an ice patrol in the Kara Sea during the season of navigation, reporting their observations by wireless to the land radio stations, and that this service be further supplemented by means of aeroplanes. It is understood that these recommendations will be carried out by the government, and that a subsidy will be paid to the firm making the most satisfactory arrangements for regular steamship service between a port on the Baltic Sea and the mouths of the Ob and the Yenisei. The vessels must fly the Russian flag, and give preferential rates to Russian goods.

A "Greenwich Time" Monument in France.—On March 11th, 1911, standard time of the meridian of Greenwich was adopted for official and railway purposes in France, in place of standard time of the meridian of Paris. Funds are now being raised to erect a "monument de l'heure" at the point where the Greenwich meridian intersects the northern coast of France; viz, at the seaside resort of Villers-sur-Mer (department of Calvados). A model of the proposed monument, designed by the sculptor Leduc, was exhibited at the Salon of 1913: Phœbus in his car, drawn by fiery steeds, holds aloft a lance with which he points out the standard meridian, while the Gallic cock, surmounting a terrestrial globe, is in the act of crowing to announce the hour of noon. The latter feature is an allusion to the fact that the International Time Conference of last October selected the wireless station on the Eiffel Tower as the central official time-piece of the world. Writing in the *Comptes Rendus*, M. L. Lecornu calls attention to the coincidence that the location chosen for the monument is very near the port of Dives, from which William the Conqueror sailed for England, thus recalling the historical connection between Normandy and Great Britain, and is also not far from the birthplace of the great astronomer Laplace. Lastly, the date on which the new time was adopted in France was the centenary of Leverrier.

Astronomy

Partial Eclipse of the Sun.—Those who live north of a line drawn from Washington to Indianapolis will be able to see a partial eclipse of the sun, if clouds do not intervene, at sunrise on April 21st. The path of totality of this eclipse will be north of 70 degrees latitude and will cross Sweden and southwestern Russia. The United States Naval Observatory has issued full calculations and maps of the eclipse. Since the observatories at Riga and Kief are in the path, it is not likely that any extensive expeditions will be sent out.

Globular Masses.—By studying the distribution of stars in the globular masses 10 Centaur, 47 Toucar and 13 Messier, E. Pickering has deduced, from observation, the apparent density, i. e., the number of stars per unit of surface at different distances from the center of the mass; he concludes that the distribution is the same for bright stars as for feeble ones, and also that the law of distribution is the same from one mass to another. H. von Zeipel has endeavored to deduce, from the apparent density on the celestial sphere, the true density in space, with partially satisfactory results. The distribution of stars near the center was represented in a satisfactory manner, but the density at the boundaries is less than that required by the theory. In a new memoir he arrives at a novel conclusion. Each of these masses is a gigantic system containing about a million stars; the number of stars visible on a plate is not the hundredth part of the total number.

Absorption of Gravitation.—Dr. Bottlinger, of Munich, has made a very interesting attempt to show that gravitation is absorbed in traversing a medium, so that the interposition of a third body between two others affects their mutual attraction. He is of the opinion that the attraction of the Sun on the Moon is enfeebled when the Earth comes between them, i. e., when there is an eclipse and it is to be remarked that the effects of two consecutive eclipses nearly destroy one another. Dr. Bottlinger admits that the enfeeblement of gravitation depends on the density of the medium traversed and is, therefore, obliged to construct an hypothesis respecting the interior constitution of the Earth. The perturbations of longitude, calculated in this way, from 1834 to 1909, are translated into a feeble oscillation of which the period is nineteen years. The epochs of maximum and minimum correspond exactly to those which have been found empirically by Newcomb. It remains to be seen whether the application to a longer interval of time will not show that on this theory we reach results which are irreconcilable with the facts.

Luminosity of the Sky Near the Sun.—Measurements have been made on the luminosity of the sky in the immediate neighborhood of the Sun. The intensity of this luminosity decreases very rapidly as we leave the edge of the Sun, and to determine the law governing this decrease it is necessary to mark out spaces in the neighborhood of the Sun, to measure their distance from the Sun, and to determine the surface luminosity in comparison to that of the Solar disk. For a certain distance the decrease in luminosity from the edge of the Sun, with a uniformly pure atmosphere, is perfectly continuous and symmetrical on both sides. With equal brightness of the sky, the surface luminosity in the neighborhood of the Sun depends on the height of the Sun; it diminishes as the height of the Sun increases. For equal heights of the Sun, it diminishes as the blue of the sky is more intense and, in consequence, as the local luminosity, measured by eliminating the rays of the Sun, is feebler. From the existence of certain perturbations in the curve of luminosity, it is proved that halos exist in the immediate vicinity of the Sun. Measures of the relative luminosities of the sky in the neighborhood of the Sun is a very delicate test of the purity of the atmosphere.

Origin of Structures on the Moon's Surface.—In an interesting letter to *Nature*, Mr. Fisher mentions a few explanations which have been given to account for the present appearance of the Moon's surface. It seems very doubtful whether the so-called craters, which are such a marked feature on the Moon, are really of volcanic origin. Dr. Johnston-Lavis writes, "the more I compare the Moon's surface with volcanic vents in different parts of the World, the less I see a resemblance between the two," and "the more does the planetoid and meteorite projectile theory become acceptable." A very interesting theory was outlined some time ago by G. K. Gilbert. He remarks that, if the so-called craters of the Moon were due to the impact of meteors, their form would be, for the most part, elliptical, whereas, in fact, they are circular. His own theory is that the Earth was at one time attended by a ring similar to that which encircles the planet Saturn, and that this afterward "gradually coalesced, gathering first around a large number of nuclei, and finally all uniting in a single sphere," the Moon. Mr. Fisher suggests that in the disruption of the Moon from the Earth, the material was scattered and that the circular so-called craters have been caused by the impact of fragments of the solid crust and that the mountains of the Moon are angular portions of the Earth's crust.

Automobile

Number of Electric Cars in Use.—According to statistics which have but recently become available, there are approximately 37,000 electric vehicles in use in the United States. Of this number, about 25,000 are passenger cars, the remainder being commercial vehicles. The city of Chicago, of course, holds the record with 2,850 vehicles. New York is next with 2,000 and Cleveland third with 1,800.

Motor Population of New England.—According to the latest authentic reports there are at present 119,115 motor-driven vehicles, including passenger and freight, in the New England States—Maine, New Hampshire, Massachusetts, Vermont, Rhode Island, and Connecticut. Inasmuch as the combined population of these States is 6,552,681, this means that there is one motor vehicle to every 55 inhabitants During the past year, the number of vehicles registered in these States has increased by nearly twenty-five per cent. The New England registrations represent about one tenth of the number of cars in the United States.

Peening Instead of Grinding Valves.—By way of eliminating waste of time and the great amount of labor involved in grinding poppet valves to a proper seat, an American company recently has adopted the somewhat novel expedient of peening them to their seats. For the purpose a special type of hard valve is used It is first accurately reamed, as is the seat, after which it is struck a number of rapid, fairly light blows with a compressed air hammer. The resultant seat is said to afford a better fit than that obtained by grinding and to resist leaks and corrosion longer and the whole operation can be completed in from 20 to 30 seconds—a material saving of time over even the best of previous methods.

Substituting Suction for Magnetism.—A small magnet on a long handle is an excellent thing to have about a motor repair shop for lifting small nuts, bolts, etc , out of obscure places. It is open to the objection, however, that it will serve only for iron or steel articles. To overcome this objection there has just been placed upon the market a somewhat similar device in which suction takes the place of magnetism. The lifter consists of a rubber suction cup at the end of a handle which is hollow and which is connected to the hose leading to an exhaust pump. A small thumb valve affords control and there is a hook for dislodging small articles. The device is intended primarily to lift sheet metal stampings from under die presses but is useful in many other ways

Cyclecar Popularity Increasing.—The popularity of that little type of automobile which has come to be styled "cyclecar" appears to be increasing, though so far the vehicle has not cut a very wide swath for itself. There are now said to be upward of 30 companies building cyclecars, most of them located in Detroit, though not many cars have appeared on the streets. One feature of the movement which may perhaps have been overlooked in some quarters is that makers appear to be finding a ready sale for their products on the other side of the Atlantic. Several instances are on record of American makers having signed contracts for substantial numbers of cars One maker, in fact, has just announced the consummation of a British contract for 10,000 cars. In the main, however, American makers are confining their efforts to supplying the American market.

Another New Automobile Motor.—Another new type of automobile motor has been added to the long list of those that may be styled out of the ordinary And as might have been expected, the newness concerns itself chiefly with the valve system. Instead of having the accepted type of poppet valves, this one has a new kind of sliding valves Across the top of each cylinder there are transverse cylindrical ports approximately the same diameter as the bore of the cylinder. In each port there is a plug with a space between the plug and the cylinder. In this space there is placed a segmental valve which is reciprocated so as to open and close alternately two ports leading to the intake and exhaust manifold The segmental valves are operated by push rods and cams In order to prevent the valves sticking, they are lubricated by pressure. The engine is now undergoing a series of efficiency tests.

For Foot Control of Steering.—Because a motor car operator's hands and arms occasionally become tired through holding the steering wheel for long stretches without rest, a Canton, Ohio, company has perfected an attachment whereby the steering of a vehicle can be controlled with one of the operator's feet, temporarily. The device consists of a formed pedal which is attached to the lower end of the steering column When the operator's foot is placed upon the pedal it drops a fraction of an inch, thus establishing it in connection with the steering gear Tilting the foot forward and backward then changes the direction of the steering wheels When the operator's foot is removed from the pedal it springs up and is thus disconnected, when the steering then is accomplished through the regulation steering wheel. It is pointed out that the apparatus possesses the advantage that it permits the operator to drive with his hands in his pockets during cold weather.

A New Theory of Sunspots

By Dr. E. A. Fath

AT the meeting of the Royal Astronomical Society in London on December 12th last, Prof. H. H. Turner, Savilian Professor of Astronomy in the University of Oxford, presented a new and unique theory of sunspots. The full text of the paper has not yet been received, but Prof Turner has given the outlines of his theory in the London *Times* of December 13th. At first glance the theory appears to be quite fantastic, nevertheless its author has been of great service in the modern development of astronomy, and whatever he says deserves a respectful hearing.

The outline of the theory is as follows:

It is well known that at times there are many spots visible on the sun, while at others they are few or entirely wanting. Observations extending over many years have shown that the number of spots varies with some regularity, the average period from maximum to maximum being about eleven years. A few years ago Prof. Schuster found evidence of other periods of about five, eight, and thirteen years. While investigating the problem recently Prof. Turner found certain breaks in the sunspot series at about the dates 1766, 1800, 1833, 1866, and 1900. In these years meteor showers known as the Leonids were particularly active. It, therefore, appeared that there might be a connection between these meteors and sunspots.

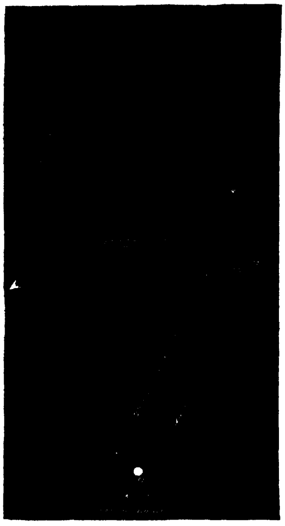
The Leonids themselves are known not to approach very near the sun, and it was therefore impossible to see a direct connection. Some intermediary was therefore required. This intermediary was supposed to be what might be called a subsidiary swarm of meteors which graze the sun at their nearest approach, and also pass so near the orbit of the Leonids that their motion is disturbed by the attraction of the latter when the main swarm of Leonids happens to pass this point.

This subsidiary swarm might have come into existence at a time when the main Leonid swarm was near Saturn The planet itself probably drew in the larger portion to itself just as the earth draws in shooting stars, but those portions of the swarm which passed through the rings might collide with the components of the latter, and so affect the motion that both meteors and the particles of the rings might be freed from the control of the planet and fall toward the sun Some would fall directly into the sun and the others would either graze or pass very near the surface of this body.

The dates of the possible encounter of Saturn and the Leonids are given, and, with one exception, these are preceded by a scarcity of sunspots and followed by a marked increase. The last encounter was in 1863 In March of that year a Greenwich observer noted that the inner dusky ring had so increased in brightness that it was nearly as bright as the other rings. This observer therefore may have actually seen the result of the bombardment of Saturn's system by the Leonids. Seven years after this came the great sunspot maximum of 1870. At about this time disturbances in the motion of Saturn in its orbit were noted. If this disturbance was due to the Leonids then the mass of this meteor swarm must be far greater than is usually supposed.

If we can assume that some of these meteors have a large mass, then their fall into the sun must produce a considerable disturbance, for they strike with a velocity of about 400 miles per second. This disturbance manifests itself as a sunspot.

We have thus briefly stated the main points of this latest sunspot theory. It leaves many things unexplained, such as the peculiar distribution of the spots in latitude, why the earth does not encounter huge meteors at times, etc It may be that the apparent connection of breaks in the sunspot series with the Leonids may be nothing more than a curious coincidence, and it certainly looks as if the author had gone far afield to find a cause which may reside in the sun itself. Nevertheless, before passing judgment on this unique theory, parts of which Prof. Turner himself says have "an appearance of wild speculation," it will be well to await the publication of the complete paper as presented to the Royal Astronomical Society.



Prof. H. H Turner suggests that there may be a connection between the meteor showers known as the Leonids and sunspots Some intermediary, however, was required, because the Leonids do not approach the sun—an intermediary found in a subsidiary swarm.

Prof. H. H. Turner's theory of sunspots.

First Magnitude Stars

By Frederic Campbell, Sc.D., Late President Department of Astronomy, Brooklyn Institute

THE world over and the year through, 8,000 stars are visible to the naked eye. Except the five visible planets of our own solar system, all these are suns. Seen through the best telescopes, their number leaps to 100 million; and photography raises it to one million million. So says the distinguished scientist, Sir E. Ray Lankester.

To become familiar with such a host is absolutely hopeless. But, just as we may have a dozen or two familiar acquaintances among the billion and a half people on earth, so is it possible to know a few of the most splendid stars. The most learned astronomer, in fact, carries at his belt but a short string of stellar scalps. The first magnitude stars are but twenty in number; and of these only fifteen are ever visible in our northern latitudes. With these fifteen, or even twenty, splendid luminaries there is *no excuse for any* man's not having acquaintance, as with so many genial friends.

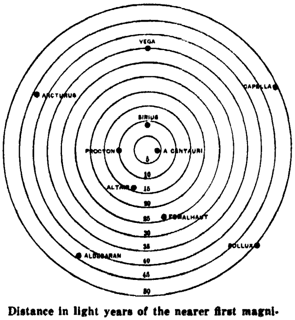
The first magnitude stars are such as appear the brightest to an observer on earth. The term does not mean their actual magnitude, either their mass, volume or inherent brilliancy. It refers only to the amount of light received from each of them at our terrestrial distance, the way they look, not the way they are. Very huge suns might be so distant or so dull as not even to be visible to the naked eye; and a fifth rate orb might be given rank among stars of the first magnitude, simply because it happens to be located comparatively near our own part of the universe.

In the table of first magnitude stars furnished herewith, there should be but little difficulty in committing to memory the names in their order, as well as the figures relating to their comparative brilliancy, their distance and their inherent light. If the southern luminaries, never seen in our northern latitudes, be omitted, the task is materially reduced. To know the facts concerning even these few stars is to know little enough concerning the universe, outside of our own miniature earth. One ought to have the ambition to extend his knowledge that far at the very least.

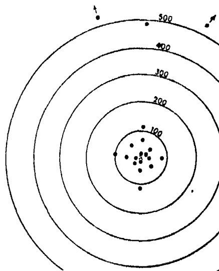
That we may comprehend the facts set before us in the table, a few remarks need to be made. We have already noted that, of the *entire* twenty, there are five never seen by us who dwell in the north. Of such immense importance are some of these, that it would be a great loss to omit them from our knowledge because they never show above our horizon. One of these is Canopus, next to Sirius in brilliancy, and 2½ times as bright as any other star seen in our north. While, as seen from earth, Canopus is second in the list, giving hardly more than half the glory of Sirius, in itself it is first in brilliancy, radiating an effulgence 10,000 times that of our superb sun. Nor are these figures mere estimates, but the result of scientific light measurements, from which the personal equation has been eliminated. Alpha Centauri, too, another southern star, third in the list, is of immense importance, as being the nearest star to earth that we know. Proximity explains its brilliance, for, in itself, it has the splendor of only two such suns as ours.

But, viewing the entire group of first magnitude stars, we see in them an illustration of the long-ago-uttered truth that "one star differeth from another star in glory." This is as true, as viewed from earth, as it is in their inherent light-possession Expressed in terms of magnitude, they run all the way from —1.6 in Sirius to 0.2 in Capella, 1.1 in Aldebaran and 1.3 in Regulus. Or, in comparisons *among* themselves, they run all the way from Sirius, regarded as 100, to Altair as 10 and Regulus as 7, the latter giving only 0.07 as much light as Sirius, yet grouped in the same class. In the matter of inherent brilliancy or absolute light-giving quality, there are immense differences, running from Alpha Centauri, with a light equal to twice that of our sun, to Altair, equal to 12 suns; to Pollux, equal to 125 suns; to Capella, equal to 800 suns; to Antares, 2,000 suns; Rigel, 4,000 suns; and Canopus, already mentioned as equaling more than 10,000

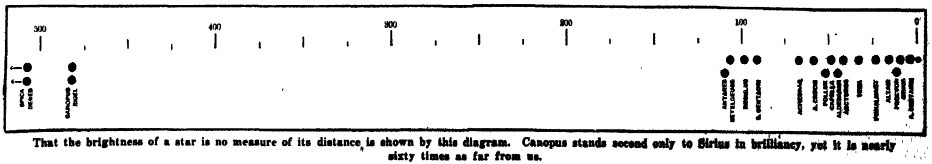
(*Concluded on page 296.*)



Distance in light years of the nearer first magnitude stars.



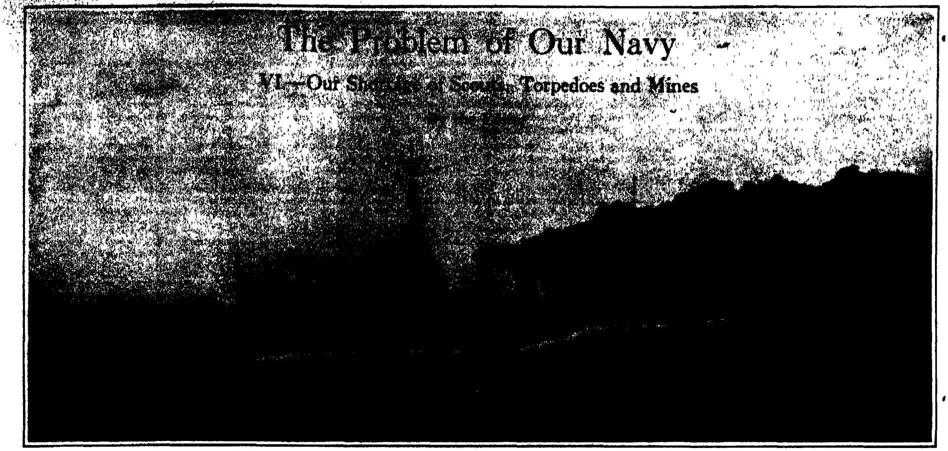
Gap of nearly four hundred light years separates the first magnitude stars.



That the brightness of a star is no measure of its distance is shown by this diagram. Canopus stands second only to Sirius in brilliancy, yet it is nearly sixty times as far from us.

The Problem of Our Navy

VI—Our Shortage of Scouts, Torpedoes and Mines



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IT is the duty—the patriotic duty—of the Press to present facts of grave national importance exactly as they are. To conceal defects, because their disclosure will destroy cherished delusions and wound the public pride, is to play traitor to a solemn trust. We offer no apology—nor will the public demand any -for drawing attention to the pressing needs of the American Navy and pointing out what must be done to bring it up to a definite standard of strength and efficiency.

We have shown that the Navy is deficient in battleships of the first class. Unfortunately, it is deficient, also, in those accessories which must be present in a certain definite proportion, if the battleship fleet is to realize its full efficiency.

Although the battleship will be called upon to play the star part in the great drama of a naval war, it must be supported by a strong cast, each filling a subordinate but most essential part. In this should be included scouts and hydro-aeroplanes for observation and information, destroyers and submarines for attack by the torpedo, vessels specially equipped for dropping mines athwart the enemy's course, fuel ships to provide a constant supply of coal and oil, ammunition ships to replenish the magazines, torpedo and mine depot ships, supply ships, repair ships, and last but not least, hospital ships

In all of these types, our battleship fleet is more or less deficient, and in most of them, fatally so. It is not our purpose now to enter into this question in great detail, but rather to confine ourselves to a consideration of three of the above types of accessories, in which we are so woefully deficient that the effectiveness of our first line of battle would be most seriously impaired, both in the strategy preceding an engagement and in the tactics which would be employed when the rival fleets were drawn up within range to fight it out with gun and torpedo.

WE HAVE THREE SCOUTS WHERE WE SHOULD HAVE THIRTY. The rôle of the scout is strategic Its work will be that of getting in touch with the enemy as quickly as possible and transmitting to the commander-in-chief the earliest possible news of his movements and probable intentions. The scout should be of high speed (not less than twenty-five to thirty knots), should possess large coal capacity, and should be of sufficient size, say from thirty-five hundred to five thousand tons, to enable it to maintain high speed in heavy weather. The scouts would be thrown far in the van of the battle fleet and disposed fan-wise over a wide area of the ocean, probably in a first and second line. The larger their numbers the closer will be their spacing, and the greater the difficulty for the enemy's scouts to pass through the screen and pick up information regarding the parent fleet.

At the present time, Great Britain possesses thirty-one scouts of from twenty-five to twenty-nine knots, Germany fourteen, and the United States three only, of twenty-four knots speed. At the present rate of construction, Germany in the year 1920, will have over thirty scouts and the United States, the way things are going at present, will have but three. Under such conditions, it would be necessary to use our destroyers for scouting purposes; but this would be to subject them to an arduous and trying service for which they are not primarily intended, a service which might impair their efficiency for the duty for which they are designed, namely, that of acting as a close protective screen around the battleship fleet. If the programme calling for the construction of six battleships per year in 1914, 1915, and 1916 be adopted, giving us a fleet of *forty-six battleships in 1920, the construction of scouts* should be taken up at an annual rate which would give us at least thirty of these vessels by the same date.

WE HAVE BUT ONE TORPEDO FOR EACH TORPEDO TUBE IN THE WHOLE FLEET Nowhere does our Navy appear so ill balanced as in the matter of our torpedo supply. As matters now stand, we have mounted in the battleships, cruisers, destroyers, and submarines about one thousand torpedo tubes; and as an ammunition supply for these tubes, we have available about one thousand torpedoes, or an average of one round per tube. We should have ten per tube This year the Bureau of Ordnance asked for the modest appropriation necessary to give us two rounds per tube. The House Naval Committee has refused it

The modern torpedo is so swift, accurate, and powerful that it promises to become a rival of the big gun as a weapon of attack; nevertheless, matters are in such a deplorable condition in our Navy that, in the event of a first-class fleet action, after firing the first round, our torpedo tubes would be entirely without ammunition!

To find a parallel for these amazing conditions we have to imagine an army taking the field with one cartridge in each soldier's rifle, or a fleet advancing to meet the enemy with only one projectile for each of its guns!

It will of course be understood that our supply of torpedoes is not evenly distributed throughout the fleet Some ships have more, some even less than one round per tube, but when we come to our fleet of destroyers, our principal arm in the torpedo service, we find, to give exact figures, that among one hundred and seventy-three tubes there are carried only one hundred and ninety-four torpedoes. This means that if our exceedingly fine flotilla of destroyers were engaged with the enemy, as soon as they had fired one round from their tubes they would be useless, either for attack or defense. The situation is so ridiculous and preposterous as to be scarcely believable

In the earlier years of the growth of our modern Navy, the development of our torpedo service went on very slowly, and we had but twelve torpedo boats in commission during the Spanish War Even such torpedo boats as we had were not used in that war for the purpose for which they were designed, and it was mainly due to the prominence given in the daily press to the fast destroyers owned by the Spanish, that in 1898 and 1899 Congress appropriated for sixteen destroyers and twenty-eight torpedoes In those days, the service was slow to appreciate the importance of the torpedo, and this apathy or distrust was shown in the fact that no torpedo tubes were fitted in the battleships appropriated for at that time. Later, we awoke to the fact that the torpedo was not only practicable, but that it was destined to play a leading part in future naval warfare, and it was finally decided to equip all first-class battleships with this weapon, and to make serious efforts to remedy the deficiency of torpedoes in the fleet.

About this time, the Bliss torpedo (an American product) was improved by the increase of the diameter from 18 inches to 21 inches, and by the application of heat to the air before introducing it to the engine The new turbine had a range of four thousand yards, and coincidently with the determination to install tubes on the new battleships, three hundred 21-inch torpedoes were contracted for, and one hundred 18-inch torpedoes were ordered for the new armored cruisers and submarine boats From that time on, the development of the torpedo in efficiency was rapid and better methods of heating, including the introduction of water into the superheater—a most important improvement which added about fifty per cent to the range of the torpedo—brought this weapon to its present truly marvelous speed, range, and accuracy To-day, the latest torpedo will run at a speed of twenty-eight knots for a distance of ten thousand yards, which is about the range at which modern battleship fleets will probably be engaged

No country has given such attention to its torpedo service as Germany. So greatly are the Germans impressed with the important rôle that the torpedo will play in future warfare, that they have directed more attention to this than to any other method of attack More money, relatively, is spent upon torpedo target practice and the various maneuvers incidental to the torpedo service, than upon any other branch of the German service The maneuvers carried out by the destroyer and submarine fleets are complicated, difficult, very dangerous, and are practically unremitting A German naval officer recently told the writer that it was believed in the German Navy that the great numerical superiority in battleships of the British, would, in the event of war, be largely off-set by the wonderful efficiency of the German torpedo service "They would win, of course," said he, "but it would be at a cost in capital ships so great as to relegate the British navy for the time being to the second rank "

Now, although our backwardness in the matter of torpedo supply may have been due in earlier years to lack of appreciation of its importance, for many years past, that is to say, from the time when the torpedo demonstrated its enormous value as a means of attack, our naval officers have urged upon the country the necessity for obtaining at once an ample supply of this weapon, by purchase abroad, by encouraging its construction by private firms, and by an increase in the capacity of the Government torpedo factory

The present dangerous and positively ridiculous conditions of one round only per tube is chargeable to Congress and to Congress alone If the moneys asked for had been appropriated, we should not now find ourselves in the possession of a fleet of first class destroyers that is practically without ammunition

It takes about one year to build a torpedo, and the cost of each is about $5,000 We shall need to secure within the next ten years from all available sources at least ten thousand torpedoes, and these will cost in the neighborhood of fifty million dollars The necessary number could be obtained, if the Bureau of Ordnance were authorized to provide for securing the needed supply before the end of the fiscal year 1924, an annual appropriation of $5,000,000 being made for that purpose

We spend $180,000,000 a year in pensions, yet we begrudge spending one thirty-sixth of that sum for rendering serviceable our fine destroyer and submarine fleets, upon which we have expended some $50,000,000!

There are three possible sources of supply first, the foreign manufacturer, second, the domestic manufacturer; and third, the Government factory Since the supply to be obtained by purchase from abroad is uncertain, and liable to be cut off altogether it should be the policy of the Government, by liberal patronage, to encourage the private manufacturers to enlarge their plants, and it should also make the necessary enlargements of its own torpedo factory at Newport.

OUR SHORTAGE OF MINES AND MINING EQUIPMENT. One of the most important lessons taught by the Russia-Japanese war was that of the deadly efficiency of the mine, whether floating or anchored. Those of us who followed the events of that war have not forgotten the terrific blow struck at the Japanese battleship fleet by the floating mines which sent the battleships "Hatsuse" and "Yashima" to the bottom; or the tragic loss by the same means of attack when the "Petropavlovsk" went down in two minutes, carrying with her Russia's ablest officer, Admiral Makaroff. Time and again the ships of the contending fleets bumped into the floating mines which had been strewn in their way by the enemy, and, if they were not sunk, they were so seriously crippled as to be put entirely out of action.

The lessons of that war have been laid well to heart by the great naval powers; and the mining service has been developed to such a degree of efficiency that it will form one of the decisive factors in the tactics of future naval operations. A most important use of this weapon will be made by the fast scout and destroyer flotillas in fleet engagements. The maneuver will consist in steaming swiftly across the head of the enemy's battleship column and dropping a number of mines across his course. This will necessitate his changing course, either toward or from the fleet with which he is engaged; and, in either case, he will be placed at a great disadvantage as regards his own and the enemy's gun fire—as regards his own, because he will be more or less in the head-on position, and his fire will be curtailed; as regards the enemy's attack, because he will be exposed to a raking fire in which the hits will be more frequent and more destructive

By way of illustrating the value of floating mines and fully equipped mining ships, specially designed for dropping them in great numbers and swiftly over a chosen stretch of water, we close this chapter with a description of the loss of the Japanese battleship "Hatsuse" during the blockade of Port Arthur. The facts were given to the writer by an eye witness, Captain, now Admiral, Von Essen of the Russian navy.

The Russians had determined by instrumental observations that the Japanese blockading fleet steamed during the daytime back and forth in front of the harbor on a pre-determined course, laid apparently between two landmarks. Accordingly, one night they sent out their mine-laying ship and dropped a string of mines, or rather two or three of them, across the Japanese course as thus determined. The next morning, a group of naval and military officers gathered, at dawn, on one of the lofty hills surrounding Port Arthur, and saw the Japanese fleet come up out of the offing and proceed to steam on its regular route The "Hatsuse" was at the head of the column; and when she entered the mine field, a huge column of water was seen to rise at her bow, and in a few minutes time this, one of the finest ships in the Japanese fleet, had disappeared!

This terrific engine of warfare destroyed or seriously crippled during the Japanese war more battleships and cruisers than the torpedo. Yet it is a fact that our supply of mines is even smaller than our torpedo supply, which, as we have seen, amounts to only one round per torpedo tube. This most serious state of affairs is not chargeable to the Navy Department, it is due to the failure of Congress in past years to listen to the warning of its naval advisers, and its refusal to make the necessary appropriations.

Gravitation and the End of the World

By John W. N. Sullivan

THE law of gravitation, as formulated by Newton, is one of the greatest generalizations in the history of science. The magnificent structure of modern dynamical astronomy rests upon this law as its basis, and the variety and grandeur of the phenomena it has proved itself able to explain, have raised it to a level of importance, and invested it with a degree of certitude, which scarcely any other generalization in science possesses to the same degree. But, in spite of this, doubts have from time to time arisen whether the law, in the form in which Newton left it, is quite exact. According to Newton, the attraction between two bodies depends upon the masses of the bodies, and varies inversely as the square of the distance between them. It has been suggested that the inverse square law is not quite accurate, and also that the relative velocities of the bodies concerned may affect the force of attraction between them. These hypotheses have been suggested by the fact that certain minor phenomena in astronomy are not satisfactorily accounted for by Newton's law. There are certain slight motions of Mercury, Mars, Venus, the Moon, and Encke's comet which exhibit discrepancies with the theoretical motions calculated on the basis of the strictly Newtonian form of the law of gravitation.

It would appear that a revision of the law has become necessary. It is highly probable that the relative velocities of bodies do affect the force of attraction between them. In fact, on the modern electronic view of the constitution of matter, the mass of a body is affected by its velocity; and the force required to change its motion depends upon the relative directions of the force acting, and the velocity of the body. So that even if the gravitational force is directly proportional to the masses, the masses themselves depend to some extent upon their relative velocities. It is possible that this is the direction in which an explanation is to be sought, of the anomalies mentioned above. But the chief difficulty about the law of gravitation is the mere fact of its existence. The aim of modern physics is to explain all material phenomena in terms of electrons and ether, but the attempt to account for gravitation in this way is attended by the greatest difficulties. We have learned to regard electricity, light and heat as forms of radiant energy, all of which are transmitted at the same velocity, but it seems almost impossible to account for gravitation along these lines. One thing which must be borne in mind is that gravitational forces are extremely minute in comparison with electrical forces, so that on an electric theory of the universe, gravitational forces may be treated as in the nature of residual effects. As illustrating the relative minuteness of gravitational forces, we may mention that if the opposite electricities were extracted from a milligramme of water, and given to two spheres one mile apart, those two spheres would attract each other with a force equal to the weight of twelve tons. In the older etheric theories, the ether was treated as an elastic solid, and in the equations to wave motion in an elastic solid we have a term which admits of compressional waves, as distinguished from the transverse waves which we know to constitute light. This compressional wave could have any velocity we please. Laplace showed that if gravitation has a finite velocity of propagation, its speed must be much greater than that of light, and he assigned as a minimum speed for gravitation a velocity one hundred million times that of light. More recent work has reduced this estimate, but it is still considered that the speed of propagation must be in the neighborhood of a million times that of light. From this point of view, compressional waves in the ether would offer no difficulty, but, as the result of a mathematical investigation by Larmor, it appears that such a theory would lead to a repulsion between bodies instead of an attraction, and a repulsion, moreover, which does not obey the inverse square law.

Lorentz endeavored to explain gravitation by assuming that in matter, considered as built up by negative and positive electrons, the attraction between a pair of electrons of unlike sign exceeds the repulsion between a pair of electrons of like sign. But on this hypothesis, the gravitational action between two bodies should vary with the nature of the intervening medium to an extent which should be easily observable, whereas a striking feature about the gravitational attraction between two bodies is that it seems to be quite independent of the nature of the medium between them. Laplace has shown that the attraction of a molecule at the center of the earth, upon a molecule at the surface, could not, in accordance with the known agreement of Lunar theory with the results of observation, be diminished by as much as one part in a million, owing to absorption in its passage through the earth.

A remarkable consequence of assuming gravitation to be an action transmitted by the ether was pointed out by Maxwell. He showed that this assumption necessarily leads to the conclusion that every portion of the ether possesses an enormous intrinsic energy, and that the presence of material bodies so influences the medium as to diminish this energy whenever there is resultant gravitational attraction. Sir Oliver Lodge estimates that the value of the intrinsic energy of the ether, when in the undisturbed condition, is of the order of 10^{33} ergs per cubic centimeter, and it is very probable that this estimate is much too low. It is interesting to see whether a maximum limit can be assigned to the gravitational force in the universe. If the number of bodies in our ethereal universe is indefinitely great, it has been pointed out by Neumann, and later by Seeliger, that the force of gravitation may become indeterminate at certain points, and even infinite. It has been attempted, but without success, to find some modification of Newton's law which would obviate this difficulty without coming into conflict with the results of astronomical observation. The difficulty may be overcome if we adopt the very remarkable hypothesis of Föppl, by postulating the existence of negative, as well as positive, masses in the universe. If the sum of such negative masses were assumed numerically equal to the sum of the positive masses, all the lines of gravitation force, like those of electric force, would start from positive masses and end on negative masses. Moreover, negative masses would attract one another according to the same law as positive masses, and in our present state of knowledge it would be impossible to distinguish a system of negative masses from one of positive masses. Of course, a system of negative masses would repel a system of positive masses in the neighborhood, but at the present time all such actions, owing to the great distances apart, assumed in consequence of these mutual repulsions, would probably be too feeble for observation.

Schuster has also pointed out that the existence of such negative masses would afford an explanation of the origin of the rotational velocity of the solar and other stellar systems.

The electromagnetic scheme does not seem sufficient to explain gravitation, but before considering some of the modern theories which have been proposed, we must deal briefly with the celebrated hypothesis of Le Sage, which was propounded in 1750, and recently resuscitated for a time by Kelvin. Le Sage assumed that all space is being constantly traversed by shoals of minute particles which subject all bodies to a state of continual bombardment. An isolated body is bombarded equally on all sides, and so is subject to no resultant force. But if two bodies are near together they exert a mutual screening action, and the result is a force tending to urge them together. Such is the essential theory, and it can be worked out so as to agree with Newton's law of gravitation. But to do this necessitates the assumption that an enormous amount of energy is being continually contributed to the universe by these corpuscles, and Maxwell showed that the heat so developed would be sufficient to volatilize the entire universe in a few moments. He remarks dryly that as a matter of experimental observation the universe is not volatilized and hence the theory cannot be true.

At the present time, in order to cope with the difficulties raised by the existence of the law of gravitation, scientific men have been compelled to assume that our ethereal universe only forms a portion of a greater universe, and to contemplate definite, physical actions extending beyond the extremest limits of that ether which fills all that we know as space. This assumption seems to be necessary, and indeed, one theory conceives our space as being merely the three-dimensional boundary between two four-dimensional universes. Such strange hypotheses would have been ridiculed a few years ago, but modern investigations in science have taught us that we are only touching the fringe of the unexplored possibilities of nature, and that we live in a universe wonderful beyond all our dreams.

From 1863 to 1875, Bjerknes published some investigations dealing with the problem of pulsations of two spheres in a fluid, pulsations being defined as consisting of periodic changes of volumes, just as vibrations consist of periodic changes of position. It appears that such pulsating spheres act on one another with a force whose principal part varies inversely as the square of the distance, and this applies to slightly compressible, as well as to incompressible, fluids. It occurred to Prof. Hicks that this method might be applied to account for gravitation, the electrons being the pulsating bodies, and the ether the fluid medium in which they are immersed. In order that the members of such a system may mutually attract one another, it is necessary that the phases of pulsation for the various electrons should not differ by more than 90 degrees. If we do not restrict the phases in this way, then the electrons will not necessarily attract one another. It would be possible for the bodies of one star system to attract those of a second, repel those of a third, and to exert no action whatever on members of a fourth system. This theory therefore provides for the existence of both positive and negative masses, and also for the existence of neutral bodies. It would be quite possible for bodies neutral to our system to be driven into its vicinity by repulsion from other systems, and thus the theory suggests the possible existence of weightless matter within the limits of our system. Sir Joseph Larmor suggests that "we may imagine the pulsation to have been applied initially over the outside boundary of the ethereal universe, and thence instantaneously communicated throughout the incompressible medium to the only places that can respond to it, the vacuous nuclei of the electrons; and we can even imagine the pulsations thus established as spontaneously keeping time and phase ever after, when the exciting cause which established this harmony has been discontinued."

It has been shown mathematically that in order that the law of attraction should reign throughout our universe, the waves impressed on the ether from that unknown and inaccessible region beyond our universe would have to have a wave length more than twice as long as the greatest distance for which Newton's law of gravitation is known by astronomical observation to hold good. The velocity of these compressional waves is taken as being 2.19 by 10^{27} C. G. S. That is to say, a light wave traveling at a speed of about 186,000 miles a second would take more than two thousand million years to travel the distance traversed by a compression wave in a second. The energy conveyed by these enormous waves is on the same gigantic scale as their velocity and wavelength. The energy passing in a second across an area of a square centimeter at right angles to the direction of transmission has the enormous value of 3.4 by 10^{41} ergs, an amount of energy exceeding by many million times the sun's entire store of available heat.

Another hypothesis which has been adopted to explain gravitation is to assume the existence of a steady hydrostatic pressure transmitted through the ether. Kelvin showed that when a steady or twistless flow is once estab-

[illegible] through one or more apertures in a movable solid immersed in a liquid, it will continue unchanged forever, but that if there are two or more such solids within a finite region, mutual forces will arise in consequence of the flow. A *steady flow of ether*, either into or out of every electron in a gravitating system of bodies, would give rise to forces of attraction between them, varying inversely as the square of the distance. The theory explains Newton's law of gravitation, and also provides for the existence of negative masses. In order to avoid the conception of the continual destruction and creation of ether, we must, in accounting for this etheric flow, assume either a slow, steady expansion or contraction of the electrons, or a flow of ether through every electron between our universe and a greater universe of which it forms a part. Since every electron must lie on the boundary of this greater universe, in the latter alternative, this greater universe must be a four-dimensional universe. This conception may be repugnant to some minds, but the first alternative also leads us to sufficiently startling conclusions. Schott has worked out mathematically the hypothesis of expanding electrons, in reality assuming a slow pulsation of extremely long period, as we can hardly suppose an electron to expand indefinitely. Dr. Schott suggests a rate of expansion which would double the size of an electron in three hundred million years. It would be necessary to ascribe to the ether a density of 10^{100} times that of water. On this theory there will come a time when the expansion of the electrons gives place to contraction, but there would be a sensible period when neither expansion nor contraction was experienced. This would mean the cessation of all gravitational attraction, and of all cohesion in bodies, in other words, a catastrophic upheaval of the entire material universe.

A Vindication of Adjustable Wings

By Carl Dienstbach

THE "Paul Schmidt" biplane, which the writer hailed as a decisive step ahead in the development of aviation, when it made its appearance in the recent aeronautical "salon" at Paris, has since furnished convincing proof of the correctness of his assertions. It has established height records of 7,000 feet with five and of 5,300 feet with six passengers. Thus it has conclusively set at rest the principal and natural objection of the constructor of the old type of aeroplane with wings and fuselage, the objection that an adjustable angle between wings and fuselage is not "practical" because the structure would be weakened. Flying and landing with such a load put the structural solidity of the machine to the most severe test possible, and, incidentally, showed how little the added mechanism increased its weight.

It has equally proved the truth of the aerodynamical and aerodromical advantages claimed for wings of variable angle, because the phenomenal carrying capacity directly resulted from this arrangement.

The pilot, Garraix, started (on January 31st, at Chartres) with the angle between propeller thrust and wing chord adjusted to four degrees; when at 3,000 feet he could not climb higher with his load, he increased this angle to six, and, to attain 6,000 feet, to eight degrees At the maximum altitude of 5,300, it was nine degrees. (The maximum angle of adjustment is 12 degrees, but this produces not the greatest absolute lift of the machine, but only the greatest lift at slow speed, for starting and landing and the "airhole." With the immense surplus lift of this machine as proved by these weight-carrying tests, it can, with normal load, be rightly acclaimed as exceptionally safe. Incidentally, the way this remarkable performance (with five up to 5,300 feet it took only 37 minutes) was accomplished, corroborates the writer's assertions as to how and why it was possible to establish a height record with a "baby" Wright racer. The only improvement still needed to realize the full safety advantages of the "Paul Schmidt" is in providing a mechanism which by power may change the inclination of the wings in case of danger as quickly and gradedly as a rudder is changed by hand—no very difficult task for an inventor. It is to be hoped that the prejudice in favor of directly-driven, relatively small propellers and of non-adjustable propellers may likewise soon be relegated, like the ancient prejudice in favor of muzzle-loading rifles, to those begotten by inventive laziness.

Wireless in the Antarctic

THE Austrian expedition under Dr. König, which is to sail for the Antarctic this year, proposes to establish a wireless telegraph station at its base in the Weddell Sea region. On its way south the expedition will erect an auxiliary wireless station in South Georgia. Thus the explorers hope to keep more or less constantly in touch with the world, as Dr. Douglas Mawson has done, on the opposite side of the Antarctic continent, by means of his two wireless stations—one in Adélie Land, and one at Macquarie Island.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Bad Orthography on Films

To the Editor of the SCIENTIFIC AMERICAN:

I cannot understand why Portuguese, or any other foreign language, could not be written on moving picture films with the same care and correctness as on some catalogues sent out by important firms of the United States. I've noticed that almost all film makers take very little care in producing a well written film. It would be ten times better not to attempt translation than to fill a drama or a tragedy with such letters as will provoke laughter owing to its absolute lack of orthography.

Another great defect is the duration of written matter on the screen. Some are too short while others tire the audience. These faults are very easily remedied

Joinville, Brazil. R W T

[Our correspondent is unquestionably correct in his contention. Here in New York the same bad spelling is noticeable. Some of the printed matter exhibited on films which have been imported from France are crude translations, obviously incorrect in some cases and unidiomatic in others As for the amount of reading matter which is offered to the public by way of explanation, it must be stated that the tendency nowadays is to reduce it to its lowest terms. Even the explanatory letter which at one time seemed almost inevitable is now encountered only occasionally. Gradually it is recognized that the film must employ its own technique, in other words that photography is not literature.—EDITOR.]

A Letter from an Old Reader

To the Editor of the SCIENTIFIC AMERICAN:

It may interest you to know that I was introduced to the SCIENTIFIC AMERICAN in 1858. It was the "Golden Key" that opened Nature's wonders to my youthful eyes, as explained to me through my father's evening readings from your journal, and who was your subscriber, along about that time, and up to 1860-61, and again after his return from "The Front."

As I remember this publication of those long ago days it was about 8 inches by 12 inches and four pages I am not positive, but it was somewhat small. I recall an incident in my life in which the SCIENTIFIC AMERICAN was a factor. In the autumn of 1858 Donati's comet was a most brilliant object in the western sky, the nucleus pointing toward the horizon, its immense tail flaming away toward the zenith. The SCIENTIFIC AMERICAN was loaded with all kinds of speculations about the big visitor bumping the earth, and of course it got my youthful mind so full of fearful ideas that I was ready to explode on the least provocation Well, one afternoon a tremendous wind and rain came tearing out of the northwest, but as our dwelling was located on the side of a big hill I could not see the approaching storm, but the roar was enough. I shouted to my mother, "Look out, here comes the comet!" I got down on my knees and put in the hottest five minutes of prayer that ever a boy did The supplication was opened in our door-yard, but the amen occurred in an adjoining cornfield. Like the darky preacher treed by a bear: "Oh, Lord, if you is going to help anybody, don't you help the bear" I was positive that the infernal thing had punched a hole in the adjoining scenery somewhere.

I always laid that "blow out" to the SCIENTIFIC AMERICAN. CHARLES W HANSEN

Erie, Pa.

Snow Removal

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of March 14th, I notice what Mr P A Hutchinson of New York has to say regarding snow removal. I fully agree with him when he says: "A power shovel, mounted on a motor truck, would seem not difficult to invent."

And further, I wish to say that one on similar lines was recently invented, and a notice of that fact mailed to Commissioners of the Departments of Street Cleaning in several large cities in this country and Canada. Each was asked if there was a demand for a machine of this kind. All answered in the affirmative, except Mr. Fetherston of New York city.

His answer follows, under date, February 23rd, 1914:

"Referring to your letter of the 20th instant, the Commissioner directs me to say that there is no demand for a loading machine. The greatest difficulty is to secure a proper number of carts to carry off the snow."

A. B. MCSTAG, *Secretary to the Commissioner.*

Doubtless if this had been called to Mr. Fetherston's attention at a time when he was not "snowed under" with work it would have appealed to him as quickly as it did to the others. If it takes one minute to load a wagon with a power shovel, and ten minutes to load one with hand shovels, it is quite obvious that the former could be kept on the move almost continually, while the second could not, thereby greatly increasing the number of loads in a given time.

I also think if dump cars were used on the street car tracks for hauling, as Mr. Hutchinson has suggested, combined with a practical power shovel, the problem of snow removal would be solved to the satisfaction of taxpayers and the public in general

Shelburne Falls, Mass F H BASSETT.

Bacterial versus Inorganic Fertilizers

To the Editor of the SCIENTIFIC AMERICAN:

I have read with great interest the recent discussion in your paper of "Bacterial versus Inorganic Fertilizers." Mr W. H. Bowker's letter shows that he is evidently not acquainted with modern agricultural thought and practice The growth of the fertilizer industry is no more of an index to its true worth than would be the development of the art of patent medicine Such things may flourish through the ignorance of customers and the desire to make money

Mr Davis, in his letter of January 24th, states the facts so clearly that there can be no room for argument

The modern farmer is a business man, cultivating food for man in a more or less finished form, and one of his great problems is that of keeping up the fertility of his soil. In doing this his greatest undertaking consists in keeping up its humus content, this being necessary to make plant food available for holding soil in good tilth and preserving its moisture-retaining powers. His nitrogen supply comes from his forage crops, alfalfa, clover, peas, vetches, etc. It is a by-product, and a steady and sure way of obtaining it is one of no cost and not at all a haphazardous matter

Mr. Bowker thinks that beginners would be satisfied if they could be grown as easily as weeds Well, they can. Sweet clover is one of the best, and is coming into greater use every year, although it was for a long time regarded as a mere weed There are hundreds of acres of alfalfa that have stood for over twenty years in a country subject to much freezing and thawing, with a recorded temperature range of from − 56 deg. to 110 deg. Fahr Mineral nitrogen may have some use in the building up of our worn out Eastern soils. Their condition is not a result of scientific agriculture, but because of the burning up of their humus, by mismanagement and the misuse of commercial fertilizers.

By all means use all the by-product nitrogen possible. This is conservation; but it is not conservation to make something by an expensive mechanical process that can be obtained as a by-product at an outlay neither in cash nor in labor INGOLL BIRKELAND

Judith Gap, Montana.

To the Editor of the SCIENTIFIC AMERICAN

As bearing on the subject of "Bacterial versus Inorganic Fertilizers," discussed by R W Davis of Moline, Ill, in your issue of the 24th of January, and by W H. Bowker of Boston, in your issue of February 14th, I am taking the liberty of quoting a paragraph from Bulletin 145, issued by the South Carolina Agricultural Experiment Station of Clemson Agricultural College, designated "Fertilizer Experiments With Cotton," which is as follows

> " We also note that where lime was applied to plots on which cow peas and vetch were grown there appears to have been a much greater accumulation of nitrogen in the soil, for these plots so treated have not responded to the use of nitrates, that is, they have given just as large yields where no nitrate was applied These experiments indicate that lime not only assists the legumes in accumulating nitrates in large amounts in the soil, but assists in some way in keeping this nitrogen from being washed out of the soil during the winter—how we are not yet prepared to say "

Since legumes that are not inoculated "fix" no atmospheric nitrogen, this is good evidence that it is possible to store in the soil through inoculated leguminous crops, where the land is limed, all the nitrogen required by the succeeding crop for its normal and continuous growth.

I would like to add that Clemson College and its fine staff of county agents advocate the feeding of the crops to farm animals so that the manure may be returned to the soil, providing not only additional nitrogen, but all the phosphorus and potash removed by the crop from the soil, with slight loss, and also a host of other bacteria of the non-symbiotic varieties, some of which also "fix" atmospheric nitrogen, and others which make insoluble compounds into available plant food

Columbia, S C EDMUND A FELDER

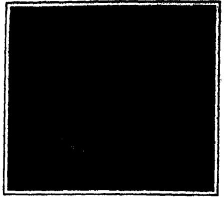
Juniper from the Indian reservations of New Mexico and Arizona may prove an excellent source of material for lead pencils. Manufacturers are searching the world for pencil woods.

Laboratory room in the Crocco-Ricaldoni Institute.

How the Scientists Are Studying the Aeroplane

Institutes of Aerial Engineering and Their Work

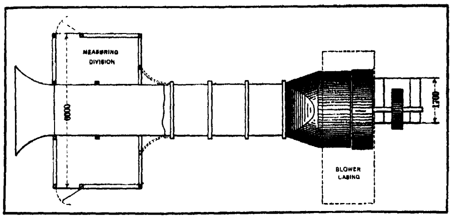
By Paul Béjeuhr



Air current lines as determined by Riabouchinsky.

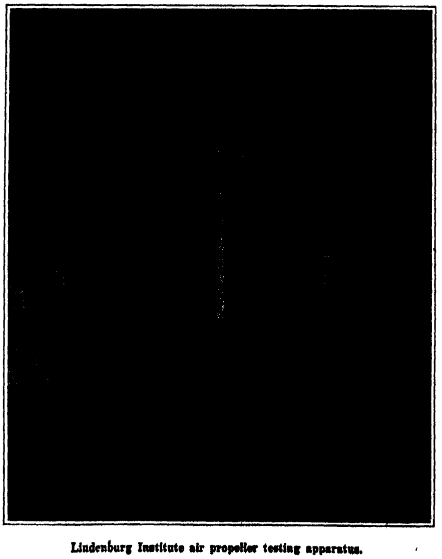
THOUGH the first beginnings of successful aerial navigation are only a few years old, nearly all civilized countries already possess research institutes for the scientific investigation of problems connected with this art. This country still uses mainly the installations provided by S. Pierpont Langley at the Smithsonian Institution of Washington, though since the death of this eminent man, a certain stagnation in aeronautical research seems to have taken place. This is the more to be regretted as Langley's rotation experiments on the air resistance of all kinds of models had been developed to a remarkable degree of perfection. It will be remembered that in connection with these experiments a steam engine, through the intermediary of a bevel-gear drive arranged below the floor, served to actuate the rotating arm which also carried all the measuring instruments The disk to be tested was fitted to a double lever pivoted round the end of the rotating arm. Under the action of the air resistance, one arm of the double lever would undergo a certain deflection recorded automatically by a style fitted to the other arm, which was kept in a central position by a system of four springs exerting a tension just equivalent to the air resistance. An electromagnet only allowed contact between the paper and style after the disk had reached a position of equilibrium, thus preventing any friction losses. The same apparatus, by a convenient combination with a falling-disk machine, a propeller testing outfit, a movable carriage, etc., was also used for other experiments. Furthermore, Langley was the first to show as far back as in May, 1896, the practicability of mechanical aeroplane models. Encouraged by these experiments, Langley, in 1903, prepared to launch a manned aeroplane designed on the same principles, but his extensive preliminary work was cut short by the aeroplane falling into the water and being entirely disabled.

In England, there are, apart from Lanchester's investigations, conducted at the National Physical Laboratory, the installations of the National Physical Laboratory at Teddington, Middlesex, where some very important work has been done. The testing plant of this laboratory is based on Froude's model tests and comprises an air channel through which a circulating current of air is drawn by a sirocco fan. The measuring channel proper is arranged in the middle, the air being allowed to return at the outside, which of course complicates the arrangement. Vertical intermediate walls and sieves serve to ensure a uniform direction and distribution of the air throughout the cross-section of the channel. The object to be examined having been introduced through a slot, is suspended from one end of a double lever, the other end of which allows the buoyancy and resistance to be gaged. These tests, made at a wind velocity of 20 meters per second, showed the buoyancy due to air resistance to reach a maixmum with an inclination of about 7 degrees The resistance coefficients of vibrating wires were also tested and found to be practically the same as with fixed wires. A rotary outfit built up of light steel tubes is used for the examination of propeller models. Another very useful arrangement is the aeroplane motor-testing plant. The motor to be tested is braked electrically by means of a dynamo, wh



Aix-la-Chapelle. Cross-section of wind channel.

Dr. Armand de Gramont's high-speed aeroplane testing track.



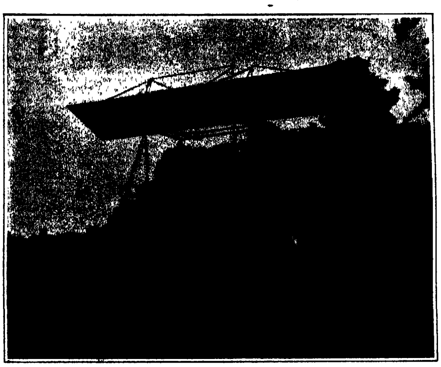
Lindenburg Institute air propeller testing apparatus.

being submitted over a cross-section of 1,200 square meters to an air current of up to 35 kilometers per hour, thus imitating, as closely as possible, the conditions of actual work. A similar motor-testing plant has, by the way, been installed by the *Luftschiffbau-Zeppelin-Gesellschaft* at *Friedrichshafen*, Germany. Another noteworthy arrangement is a lattice tower about 65 feet in height, with a rotatable platform for gaging air pressures on disks in a natural wind. These experiments have for instance shown a considerable increase in the intensity of the wind at a given place during 5 minutes, whereas no such increase could be observed at 137 meters distance. Arrangements for hydrodynamical tests have been made to supplement the former; the models used in this connection are at rest while the water current moves at speeds as uniform as possible throughout the cross-section.

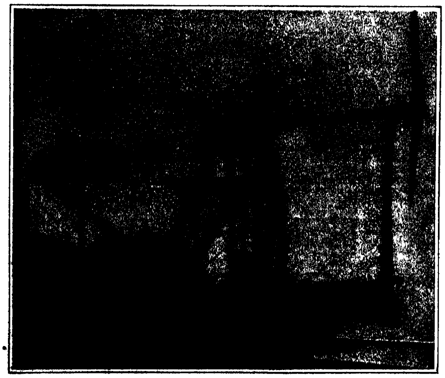
Another remarkable English installation is the large air propeller-testing plant at Messrs. Vickers Sons & Maxim, Ltd., works at Barrow-in-Furness. This comprises a rotating lever 50 meters in length, the measuring arm of which, 33 meters in radius, turns in ball bearings round a huge cast-iron pillar, whereas the other arm carries the counterweight. Above the pillar there is the observer's cabin, where, in addition to any necessary instruments, a 100 horse-power electromotor for use in driving the propeller has been installed. Thus, this rotating outfit is only actuated by the air propeller itself. Thrusts are recorded by a slight axial displacement of the propeller shaft with the aid of angular transmitting levers, and the work expended is determined by examining the electromotor. This testing plant shows the advantage of eliminating the effects of wind.

Especially numerous are the aerodynamical institutes in France, as might be expected in a country which takes so eminent a share in the development of aerial engineering. Those created by M. Eiffel—mainly for investigating the laws of air resistance—are especially well known. After performing extensive falling tests from the lowest story but one of the Eiffel Tower, he erected a special aerodynamical laboratory on the Champs-de-Mars which mainly contains an air channel where tests on immovable models with artificial air currents are made. A sirocco ventilator, 1.75 meters in diameter, draws in some air from the laboratory hall, conveying it round its sides into a larger hall where it is allowed to calm down, in order, eventually, through a system of channels, to return, at the proper speed, into the laboratory hall. Between the air outlet and the suction tube there is the experimental room proper. The disks or other models are suspended from a special balance which, by slight adjustment, allows the resultant of the buoyancy and resistance to be ascertained. This balance is installed on a bridge above the laboratory room proper. The well-known steam-turbine constructor, M. Rateau, has installed a similar plant for the testing of models in a moving air current, in connection with which the air is likewise allowed to pass freely through the laboratory room proper, whereas, in all other testing plants (Prandtl, Reissner, Riabouchinsky) there is always an air current moving through a closed channel, which can therefore not be entered during tests. The most recent creation of France is the Institut Aérotechnique of the Paris University at St. Cyr, founded by Henri Deutsch de la Meurthe. This comprises, on a large plot beside the main building, a special rotary test-plant shed and a straight track 1,360 meters in length, which will be used for resistance tests on disks placed in a natural air current, as well as for the testing of propellers. The main building comprises a huge exhibition hall which will at the same time be used for all kinds of experiments, and to this are connected on both sides the laboratories and research rooms, while the testing machinery takes up one of the transversal sides. The testing truck, on the straight experimental track, is propelled at a speed of up to 25 meters per second, by electro-motors deriving their current from rails running alongside the track, and as these motors are steered from the roof of the Institute, the trucks can be run unmanned. The traveling speed is recorded by a chronograph and tachograph, and the resistance thrusts on the surfaces are tested by hydraulic measuring instruments actuating special recording manometers.

St. Cyr testing car for use in resistance and propeller tests.



Prof. Donat Banki's arrangement for the testing of monoplanes.



Prandtl transportable testing plant, the carriage being driven by the propeller itself.

Reference should also be made to the tests made by Dr. Armand de Gramont, Duke of Guiche, which mainly relate to the distribution of pressures on disks in a natural air current. The disks used in this connection were fixed to an outfit installed above an automobile traveling at a high speed on a good forest road, where practically any side wind was kept out.

In Italy should be mentioned the arrangements provided by the *Brigata specialisti* on plans by Captains Crocco and Ricaldoni, which are continually being extended. The wind channel used in this connection shows the special feature that measurements are made just in front of its mouth, after which the air is allowed to escape into the open. The fan 2.5 meters in diameter has thus always to draw in a new supply of air; it is operated by a 30 horse-power electro-motor, and imparts to the air current a speed intermediary between 2 and 29 meters per second. The air current at first enters a large iron tank where it is allowed to calm down. Having thus been freed from any eddies, it penetrates through a tube one meter square into the laboratory-room proper. A traveling frame from which the models are suspended is moved in front of this mouth. An improved Renard dynamometrical balance is used to gage the work induced in the air propeller, independent of any losses in the driving motor and transmission devices. This balance comprises a light frame in the center of which the propeller to be tested is so suspended that the air current undergoes no deflection. Any motion in the direction of the air current is compensated by a proper weight put on a vertical arm of the frame. The propeller obstruction (due to its torque) manifests itself by an inclination of the whole frame and is likewise compensated by weights. The results obtained in connection with the testing of dirigibles by means of special models suspended in a Cardan frame have been of especial value. A large tank, which is to be replaced by a canal 188 meters in length, 3 meters in width and 2 meters in depth, is used for tests on moving models in resting water.

Extensive tests have also been made on propellers (at first on models and afterward on actual propellers) either in a stationary plant or on a gliding boat.

In Russia there are at present three aerodynamical institutes, both the University and Technical High School of Moscow being connected with testing plants, while a third institute at Koutchino is conducted by its founder, Riabouchinsky. The Institute of Moscow University has been in existence since 1902, and comprises two minor air channels, one of which is 1.6 meters in diameter and admits of an air speed of 20 meters per second. Into this channel is introduced a propeller testing apparatus, in connection with which the electro-motor, direct-coupled to the propeller, is arranged in a light frame free to rotate as a simple lever round a point in the channel wall, its weight being compensated by proper counterweights. The propeller thrust manifests itself in the same sense, and is likewise determined by weights. The Institute also comprises apparatus for falling tests and experiments on the escape of highly-compressed air. Of the aerodynamical arrangements of the Technical High School there should be mentioned a special measuring channel designed for investigating the air resistance of plates the length of which is very large as compared with the width. The arrangements installed by Riabouchinsky are of the most varied description and relate to all the different branches of aerial navigation. Measurements in a moving air current are made in a huge air channel through which the air is drawn, not from the room itself, but from a larger cylinder which likewise serves to calm the motion of the air. In connection with model tests up to diameters of 0.5 meter, a modified Renard double balance is used. In the case of large propellers (4 to 10 meters in diameter), a somewhat different arrangement is employed, the propeller working in an upward direction against the free air stratum, thus exerting a downward thrust which is transmitted by a step bearing to a recording style. A set of beveled wheels is used for measuring the induced work.

Experiments here have been made mainly on the influence exerted by the number of vanes on the efficiency of a propeller; up to what limits the projection of the vanes on the surface of the propeller circle can be increased, and similar problems. Most interesting resistance tests on disks in flowing water were made in a little river in the neighborhood of the Institute. Especially striking comparative tests have been conducted on the Ahlborn current lines in air, by means of a square plate lined with black paper on which lycopodium powder was spread uniformly.

In Germany there are, in addition to the research laboratories of the large aerial navigation companies and aeroplane-building firms (Testing Department of the Corps of Engineers, Zeppelin Company, Parseval Company, Siemens-Schuckert Werke, Messrs. Lanz, etc.), the Testing Institute of Professors H. Junkers and H. Reissner at the Aix-la-Chapelle Technical High School, the Aerodynamical Laboratory at Lindenberg, and the Aerodynamical Testing Plant of the Motor Airship Study Company at Göttingen.

The Aerodynamical Laboratory of the Aix-la-Chapelle Technical High School comprises an air channel through which the air is drawn by means of a centrifugal fan. In opposition to the Göttingen plant, where the same air current is used in continual operation, a new supply of air is always drawn in, thus allowing higher velocities (so far, up to 30 meters per second) to be reached with the same motor output, while insuring a great homogeneity, though these advantages are of course offset by the dependence on actual wind conditions. This plant has so far been mainly used for propeller tests.

The Lindenberg Aerodynamical Laboratory likewise is mainly intended for use in testing air propellers, no models but actual propellers being used and, as far as possible, under the natural conditions they will be called upon to work. The testing machine is operated by a 34 horse-power electro-motor through a belt and beveled wheels, and produces 40 to 600 revolutions of the propeller per minute. A hollow shaft and an axle rotating inside allow the two propellers to be driven in opposite directions. The propeller thrust can be compensated by means of step bearings, levers and weights, and the induced work is gaged hydraulically. A large number of systematical determinations have been made by means of this outfit, which yields especially valuable information on the working of lifting propellers. Experiments with manned and unmanned kites made at Lindenberg exceed in point of accuracy any work of a similar kind

The model testing plant erected at Göttingen, on plans by Prof. Prandtl, mainly comprises a closed endless channel of square cross-section (2 meters square), inside of which the air is set in continual motion by a ventilating fan A special regulator allows any wind velocity to be maintained irrespective of fluctuations in the mains feeding the electro-motor A system of tubes of decreasing diameters distributes the air current uniformly over the whole cross-section, and a sieve with fine meshes eliminates any eddies Resistances are determined by means of balances and sliding weights, and the distribution of pressures is read by means of micromanometers The velocity of air currents is gaged by means of improved Pitot tubes. Balloon models are produced electrolytically on wax models, thus allowing a remarkable accuracy and low weight to be obtained. A propeller testing plant has been added

A laboratory equipment likewise installed on plans by Prof. Prandtl, from funds of the First International Aeronautical Exposition (1909), held in Frankfort-on-Main, will most likely be used to supplement the Göttingen in-

(Concluded on page 300.)

The Most Powerful Government Wireless Plant

The United States Naval Station at Radio, Virginia

By John L. Hogan, Jr.

LESS than a year ago the Navy Department's most powerful wireless telegraph plant, at Radio, Va., near Washington, was completed, tested and taken over from the contractors. The towers and buildings were constructed for the Department from Navy plans, but the radio apparatus was designed and installed under the patents of Prof. R. A. Fessenden. The Radio station is the first of a proposed chain, linking by wireless the United States possessions throughout the Atlantic and Pacific, and its completion marked the first step in the realization of plans laid out by the federal radio authorities as early as 1909. At present work is going forward on similar high-powered Government plants in the Canal Zone and on the Pacific, so that before long it is expected that the more important centers of United States territory will be able to intercommunicate by naval radio, entirely independent of privately owned wire lines or cables.

Even in the absence of the additional power radio stations proposed, the plant near Washington is proving of great value. Time signals are sent out at several fixed hours each day, and by adjusting their wireless instruments to receive these impulses, officers aboard ships at sea are able to compare their chronometers with those at the Naval Observatory even though one or two thousand miles away. Equally valuable to the masters of vessels along the Atlantic seaboard are the

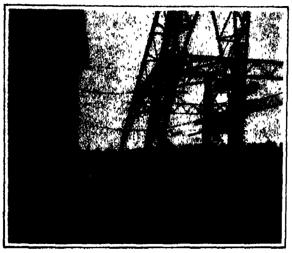


Fig. 1.—The aerial switch.

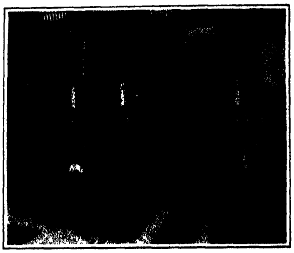


Fig. 2.—Compressed air condensers and rotary spark gap.

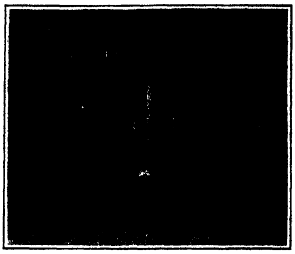


Fig. 3.—General view of the transmitter.

Fig. 4.—Tower leg and pedestal. Each leg rests on a similar concrete pedestal, and is equipped with a high potential switch.

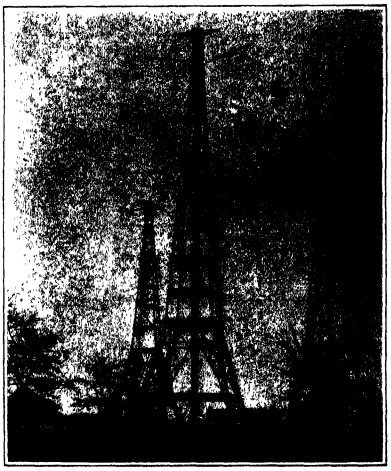


Fig. 5.—The towers and buildings at Radio, Va.

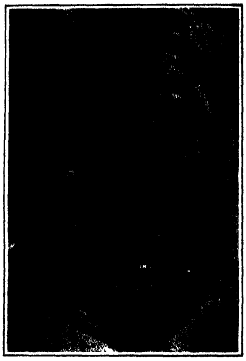


Fig. 6.—The rotary spark gap. Sparks can occur only when the revolving spokes are directly under the stationary electrodes.

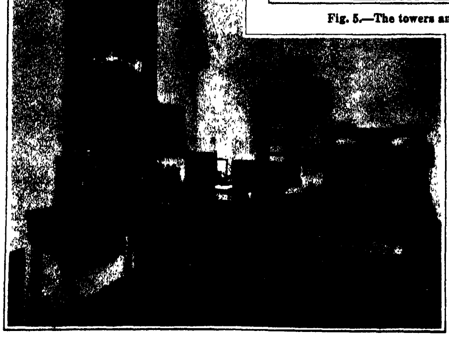


Fig. 8.—The receiving- and operating-room.

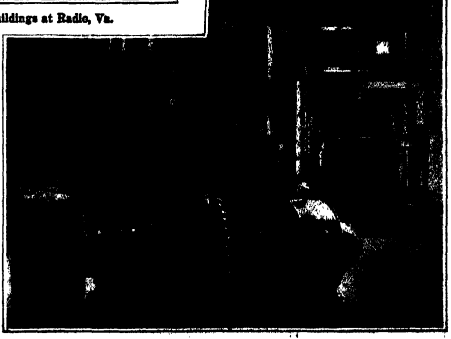


Fig. 7.—The transmitter, showing the 200 horse-power motor.

storm, ice, and derelict warnings transmitted at scheduled times along with various important weather and meteorological reports. Aside from these aids to navigation generally, the Navy Department is able to issue orders direct to any ship within two thousand miles or so, and likewise may transmit from the head offices of the wireless service, at Radio, direct to any of the naval installations along the Atlantic, and even to some of the Pacific coast stations. It has been the daily custom for the Radio station to exchange messages with the naval plants in range, beginning with Portland, Me., and taking in turn Boston, Newport, Brooklyn, Philadelphia, and the southern stations through North Carolina and Florida down to Colon, Panama. Tests between Radio and San Francisco are now being carried on, and it may soon be possible for these two stations to intercommunicate reliably at any time.

The apparatus and plant which makes possible this exceptional sort of radio transmission is interesting in all its details. As shown in Fig. 5, the station at Radio includes three enormous steel towers for supporting the antenna or aerial wires, and a large building divided into three parts. The central hall of this building contains the entire transmitting equipment, while the right hand wing (which is really an entirely separate structure) has in it the receiving room, a laboratory, and living quarters for the station personnel. The remaining wing is divided into additional laboratories, a machine shop and the executive offices of the Naval Radio Service. Near the extremes of the buildings, and 350 feet apart, are placed the two 450-foot towers. The 600-foot tower, shown in the foreground in the accompanying general view of the towers, is 400 feet from each of these, and stands at the acute apex of an isosceles triangle formed by the three. Fig. 4 shows a tower leg. Each of these legs rests on a similar reinforced concrete pedestal, and is equipped with a high potential switch for connecting the steel framework directly with wires buried underground. It has been found that the station transmits more efficiently when the towers are "grounded" in this way, and in addition the possibility of damage to the bases from lightning stroke is minimized.

From spreaders slung from the topmost point of each tower is threaded the enormous triangular fan of aerial wires which, when energized by the sending apparatus, sets up the powerful electromagnetic waves used in wireless transmission. These same wires are used in receiving messages, to collect from the ether the electrical power which brings signals from distant transmitters. On top of the wooden pole in the right-hand foreground of another illustration appears the aerial switch, which when operated by chains and levers from the receiving room connects the antenna wires to either the sending or the receiving instruments. A set of vertical wires drops from the big aerial fan to the top of the aerial switch, and by throwing the switch lever to the left or to the right the station is arranged either to send or to receive.

When the aerial switch is in its left-hand position the overhead air wires are joined to a large copper tube which is brought into the sending apparatus room through a glass window, as shown on the extreme right of Fig. 7. This photograph shows the entire transmitting equipment, and in it and Fig. 3 there may be traced the connection from the aerial through the tuning coils on top of the framework and down to the ground wires under the floor by way of a flat copper strip fastened to the central upright and leading through an electric current meter which shows just how powerfully the sender is operating at any time In the foreground of Fig. 3 is shown the 200 horse-power motor which drives the radio transmitter dynamos and rotary spark gap. The electrical power as furnished by the central station near Washington is not suitable for producing the clear ringing musical sparks used in modern wireless telegraphy, and so it is necessary to convert it by means of the motor and dynamos shown. After this conversion, the power is led through the sending-switch and transformer, and then, at a potential of about 25,000 volts, to the rotary spark gap of Fig. 6. In jumping from one of the stationary electrodes at the top of this gap to the revolving spokes and then back to the other stationary electrode the electrical condensers (the vertical cylindrical tanks of Fig. 2) are discharged through the left-hand coil shown at the top of Fig. 3. Sparks can occur only when the revolving spokes are directly under the stationary electrodes, and during the intervals between each two spark discharges the condensers are recharged with electricity from the transformer. The condensers themselves consist of steel disks interlaced and supported on rods inside of the tanks shown. These tanks are filled with dry air pumped up to a pressure of 200 pounds to the square inch, which high pressure prevents electrical leakage and consequent losses in the condenser. The compact installation of this powerful transmitter was made possible only by the use of these compressed air condensers.

There are 48 spokes on the rotary part of the spark gap, so that when this revolves at its normal speed of 1,250 revolutions per minute sparks will occur at the rate of 1,000 in each second so long as the sending-switch above mentioned is held closed. This sending switch is operated by a magnet and controlled from a Morse telegraph key placed in the operating and receiving room. When the operator presses this key for short and long intervals corresponding to the dots and dashes of the Morse telegraph code, the sparks pass for identical short and long intervals. The spark-discharge currents acting inductively across the transformer tuning coils shown in Figs. 7 and 3 force the aerial wire system to emit into space similar short and long groups of electromagnetic waves, which travel along the earth's surface to the receiving station. The fact that the sparks occur only one one thousandth of a second apart causes them to produce a high, clear, musical note, corresponding in pitch about to the second C above middle C on the piano, and this characteristic tone is reproduced at the receiving station. The receiving operator, holding to his ears a pair of ordinary Bell telephone receivers, hears the short and long musical sounds made by the transmitter, and is able to retranslate them into words according to the telegraphic alphabet, distinguishing them by their tone from the scratchy and meaningless sounds of natural atmospheric electrical discharges.

Fig. 8 shows the receiving- and operating-room of the Radio station. The wire from the aerial switch runs down the back wall and may be connected to either of the two complete receiving instruments which are installed. Underneath the operating table is the lever controlling the aerial switch on the pole outside, and mounted on the table top is the telegraph key by which Morse signals are sent out from the transmitter in the main building. Since messages must often be received from small stations at such great distances that the incoming signals are very faint, the receiving-room has been built as nearly sound-proof as possible. A system of mechanical and electrical interlocks protects the operator from electrical shock in case he should attempt to send before disconnecting the receiving apparatus from the aerial wires, and signal lights permit him to communicate with the engineers running the sending dynamos. A Telautograph, or writing telegraph, connects with an adjoining room in which are installed telephone and telegraph instruments connecting to the commercial lines, and by its use faint messages being received by radio may simultaneously be relayed out over the land wires by a second operator without danger of the clicking of telegraph sounders disturbing their reception.

In the months that the Radio station has been in operation it has not only filled a great need by the transmission of time and meteorological signals, but it has also demonstrated its service efficiency by the establishment of many new records for consistent long distance radio signaling. Its performance has indicated definitely that as the projected series of high powered stations reaches completion the United States will own a chain of wireless plants which will lead the world in efficiency and utility.

Attractions of Variable-star Observing

By Edward Gray, M.D.

IN all North America there must be some scores of telescopes possessed by amateurs which are more or less idle or at least producing no contributions to science, mainly because their owners do not know how to use them profitably. After a period of recreation among double stars, the moon and the planets, does not many an amateur weary of finding nothing new and possibly even relegate the telescope to the attic?

At this juncture comes in the value of variable stars. It can only be want of knowledge of the pleasure along with usefulness of variable-star observing which has kept back amateurs from pursuing this branch of study and recreation. Is there indeed any other line open to amateurs, if we except the observation and discovery of comets, wherein the amateur may do original work of value and where his results may be made useful to the present and to future generations?

It is the aim of this article to point out how inviting a field to amateurs is the observing of variable stars, mainly those of long period. To begin with, it is a field but little cultivated and where hundreds of thousands of observations are required by astronomers for study. One's equipment need not be expensive or elaborate. A good field-glass will suffice for a small minority of observations; but in general a refractor of some aperture between two and seven inches or a reflector of four to nine inches is requisite. Two observers are known to me who use rather small apertures, namely, two and two and a half inches; and each does good work.

An equatorial mounting is time-saving and convenient to work with, but cannot be reckoned essential; perhaps a majority of the observers now in this line use a tripod mount. This implies much more work at first in learning the fields, but rapid work thereafter. After two years' practice, for example, a valued correspondent cited an evening when he had made twenty-six estimates and was back in the house at 8.50.

The periods or cycles of the stars to be observed vary greatly in length, from two months to well nigh two years. Hence the state in which variables are found at any given time varies much; some are waxing in brightness, some waning: a few are at, or near, maximum, others at minimum, and still others resting before either rising or falling. All this insures variety, there is nothing tedious about observing variable stars. Surprises are frequent and one's interest is kept alive; for while some stars are perfectly regular and move like clockwork, others are irregular enough in their fluctuations to furnish all the mystery necessary Some are white, some yellow, some orange, some red, and a star red at or close to minimum may become orange or deep yellow near maximum It does not at all follow that because the last period of *SS* Cygni was nine weeks in length, the next one will be the same. On one occasion I found an interval of only forty days, an occurrence unique in my acquaintance with this star.

Beyond the telescope—and some place to use it—one's equipment requires only a good star-atlas and a number of charts of the variables to be studied The intending observer should associate himself with the Society for Practical Astronomy (Chicago) and its Variable-Star Section or with the Association of Variable-Star Observers (Norwich, Conn). The two bodies are co-ordinate, and most of those now engaged in this line belong to both. The necessary charts are procurable from the members and further from Harvard College Observatory, but conditional in this last case that a monthly report be made to its director. These charts once received, patience and perseverance do the rest. The way of the beginner is now easier than it was three or four years ago. There are magazine articles and manuscript "hints" which illuminate the path.

At present the literature is scattered in various magazines. The Society for Practical Astronomy publishes a *Monthly Register*, while the monthly reports of the Association of Variable-Star Observers appear in the magazine *Popular Astronomy* (Northfield, Minn.). These observations have grown to number 800 to 1,200 per month, according to the weather

More observers are needed, however, to carry on the work properly. Volume 55 of the Harvard *Annals* says, for instance, of X Monocerotis, "Very few visual observations have been published, since the star does not appear to go below the tenth magnitude. It could easily be followed with small telescopes; and continuous observations, when the star is not too near the sun, are needed to learn the nature of the changes of this interesting variable."

Seldom does one pursue this line of research for six or more months without describing it as fascinating. But if the mere observing is fascinating, what shall we say of the intellectual profit and expanse of mind to be attained therefrom? For there are problems connected with those stars which may exercise even the best intellects. Why do some variables like R Hydrae and ε Boötes shorten their periods, while others, like χ Cygni, lengthen theirs? Why does Mira Ceti sometimes barely exceed the fifth magnitude at maximum and at others attain the second? Why again does this star descend to the eighth magnitude only at some minima, but at others to the ninth, perhaps 9½? And why should it vary up to twenty days in either direction from its mean period of 331 1/3 days?

What physical cause is there why U Geminorum, *SS* Cygni and *SS* Aurigae should remain close to minimum for weeks or months and then suddenly rise, attaining maximum in a very few days? Why do very red stars usually have very long periods? And so on to more complex queries

Astronomers require a vast number of observations to accumulate data required for elucidating the many problems relating to variable stars

To sum up:

1 Observing variables is the chief line open to amateurs in which they may do good work and put their telescopes to useful account.

2. This pursuit has a charm which must be experienced to be appreciated It does not grow monotonous

3 It has an educative and intellectual value *sui generis*. This can be better understood after a practical acquaintance with the pursuit

4. It is not very costly.

5. It leads to the formation of desirable acquaintances; for a cordial *esprit de corps* exists among its devotees.

6. It requires method in observing and in recording results, and leads to habits of exactness; likewise to the setting of problems to be worked out and to a desire for higher knowledge. Its influence is altogether wholesome upon mind and brain and temper. It is an uplifting pursuit.

7. It is constructive, not destructive; and adds to the sum of human knowledge.

A Wonderful Model of a Copper Mine

By J. W. Grigg

PROBABLY the most elaborate and realistic copper mine model in any museum in the world has just been placed on exhibition at the American Museum of Natural History. It required more than three years' work to complete it. The mine reproduced is that of the Copper Queen Consolidated Mining Company's property at Bisbee, Arizona. It was executed under the direction of Dr. Edmund Otis Hovey, curator of geology, by Mr. Arthur Briesemeister and assistants, and was reproduced from accurate and first-hand study of the mine itself.

It is another of the many interesting exhibits planned and completed in recent years at the museum in an effort to bring the institution into closer touch with the people, and to make the institution as interesting as possible to the person without scientific training.

It was early in 1910 that Dr. James Douglas of the company informed the museum authorities that he was prepared to furnish the data and the means necessary for the construction of a large scale model of the mine. That summer Dr. Hovey took his assistants to Arizona, where the first thing done was to determine upon the point of view from which the picture of the model as a whole with its proposed painted background should be obtained. Practically the same view is now spread before the observer in the museum.

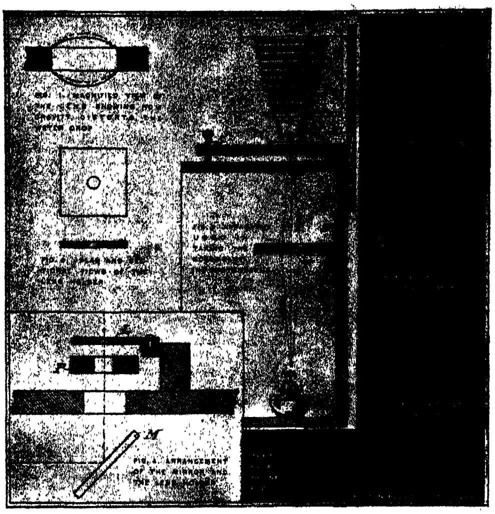
The model is 18 feet 6 inches long by 12 feet wide, representing an area 5,315 feet long by 3,418 feet wide. There are more than 500 structures represented in the model, including loading bins, dwelling houses and other buildings. After experimenting with wood, plaster, and other materials, the metal buildings, which are corrugated iron in the field, were made of brass covered with thin zinc foil scored to represent the corrugations to scale, while the dwelling houses and some small structures were made of cardboard. The head frames, loading bins, railroad tracks, etc., were made of brass.

The museum men in the field made records even of the color of paint on the different buildings, the nature of the material used in construction, the shape and character of the roofs, the position and nature of vines, shrubs, and trees, and in fact all other features that would be useful in making a naturalistic reproduction of the portion to be represented.

Originally it was intended to represent only the surface, with a painted background showing the Mule Mountains, but as soon as the work was actively begun it was considered of utmost importance that the underground workings should be represented as well. It was decided, too, to make a working model of a single stope on a scale of six feet to the inch to represent details that could not be indicated on the big model.

The representation of the underground work could be accomplished only by excavating the under portion of the model, and to place in the hollows thus formed reproductions of the stopes in solid wood, cut according to detailed plans of the levels as furnished by engineers of the company. Tunnels, raises, winzes, and shafts were likewise constructed to scale according to these plans and inserted in their proper places.

The sides of the model were used to give the geological sections along several vertical planes from 4,100 to 5,900 feet above the sea.



Water-drop microscope and photomicrographs made with it.

At work on the copper mine model of the American Museum of Natural History.

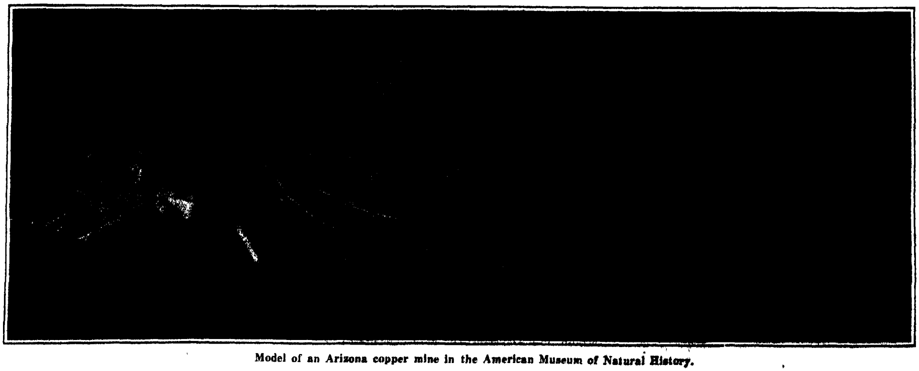
The Water-drop as a Microscope

By James Bailey

THAT a drop of water has the power of magnifying a hundred diameters astonishes most of us, and yet we are familiar with the properties of water, which make it suitable for a lens. We know that, when free, a drop of water assumes a spherical shape, we know that a lens is formed by grinding glass so that it has spherical surfaces, also that water like glass has the power of bending light rays. A free drop of water, therefore, has the two main properties of a lens, i. e., spherical surfaces and refraction. A free drop of water, however, is useless as a lens, but by a suitable holder the lens qualities of the liquid can be maintained and the drop readily handled.

The theory of the lens is quite simple. Consider the holder shown in Figs. 1 and 2, and neglect the effect of gravity for the present. The water or liquid used is prevented from falling out of the holder by adhesion. The surface tension of the liquid causes its surfaces to act like thin sheets of rubber fastened to the upper and lower edges of the holder. These edges being true circles, any pressure from within distorts them into spherical shells as shown by the dotted lines in Fig. 1. If the space between these is filled with water a lens is formed. The effect of gravity is to lower both surfaces and to distort them from the true spherical shape as shown by the solid lines. This corresponds to the actual condition and approximates the shape of the liquid lens as used. It can be easily shown that this distortion increases with the diameter of the holder, and as more liquid is added to

(Concluded on page 294.)



Model of an Arizona copper mine in the American Museum of Natural History.

The surface of the ground was modeled in clay on a wooden core. Many photographs had to be taken on the spot in Arizona so that every detail could be accurately reproduced.

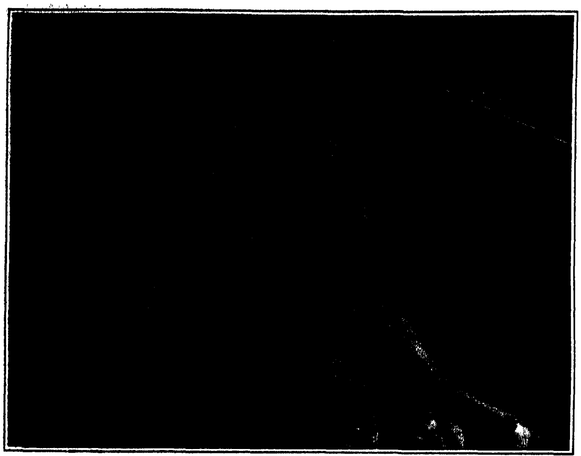
Finishing the Work at Panama

WERE it not for the troublesome slides, the Panama Canal would to-day be a completed task; indeed, had it not been for the Cucuracha slide, the work of excavation would have been completed and the canal would have been made ready for opening at least one year before the time officially set for that event, namely, January 1st, 1915. In speaking of the Cucuracha slide, it must not be forgotten that this vast earth movement represents, after all, but a small part of the total amount of excavation that has been added to the original estimated amount by the earth and rock movements along the canal, and chiefly in the great Culebra cut.

To realize the magnitude of the task superadded by the slides, we must remember that it cannot be measured merely by the total yardage which has had to be removed. This in itself is large enough, Heaven knows, for it has reached the enormous total of 30,000,000 cubic yards, the removal of which in itself would constitute an engineering feat of the first magnitude. We must remember that in addition to the mere work of removal, the slides have imposed other burdens, due to their interference with the operation of the enormous excavating and removal plants, which have covered the bottom of the cut at all times during the progress of the work.

Frequently the slides have moved entirely across the cut, burying the tracks, filling up the drainage ditches, breaking the pipe lines for conveying air to the air drills, and otherwise upsetting the whole material organization.

Nevertheless, in spite of these interruptions and in spite of the enormous additional burdens of excavation imposed, it has to be recorded to the eternal credit of the engineers they have succeeded in steadily lowering the cost of excavation. This reduction in cost has been so great that it has about covered the increased cost of removing the slides.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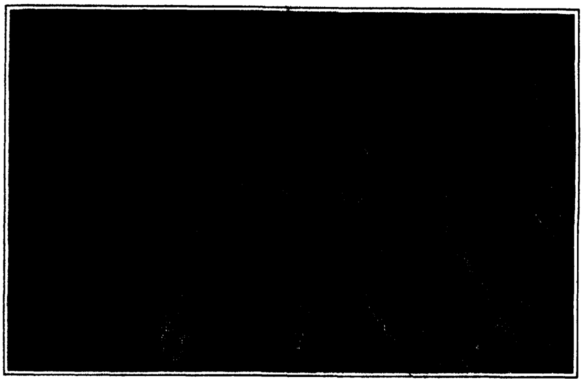
Completed locks at Panama, showing at left an electric towing locomotive.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One of the Gatun locks serving as a drydock for submarines.

At the present writing a channel about 200 feet wide has been opened past the Cucuracha slide, and, as will be seen from our illustration, the dredges and the hydraulic monitors are steadily at work, the former removing the material from the toe of the slide, and the latter sluicing it away from the upper levels. According to the latest reports, Col. Goethals expects to have the channel so far cleared that it will be open for experimental navigation by ocean-going steamers on the first of July of the present year. The intervening time between that date and the day of official opening will be devoted to the drilling of the operating forces and getting everything into thorough working order; so that when the canal is opened to the commerce of the world, both the machinery and the operating forces may move with precision and a complete absence of delay.

The construction of the fortifications at each end of the canal is nearing completion and the mounting of the mortars and long-range rifles will probably be begun during the coming summer. Recently five submarines were dispatched to the Atlantic end of the canal to form part of the permanent defenses. Shortly after their arrival, the little craft were drydocked for overhauling and cleaning. Drydocks are being built at each end of the canal; but as these were not available, use was made of one of the locks at Gatun, and the submarines were docked side by side as shown in our illustration. So far as we know, this is the first time that locks have been used for this purpose.

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Dredges at work removing the Cucuracha slide.

A New Method of Sterilizing Milk

A NEW German invention for producing germ-free milk, known as the "biorisator," is said to be in successful use at dairies in Leipzig and Düsseldorf, and a favorable report upon it has just been made by W. Freund, who has investigated it on behalf of a German association of wholesale milk dealers

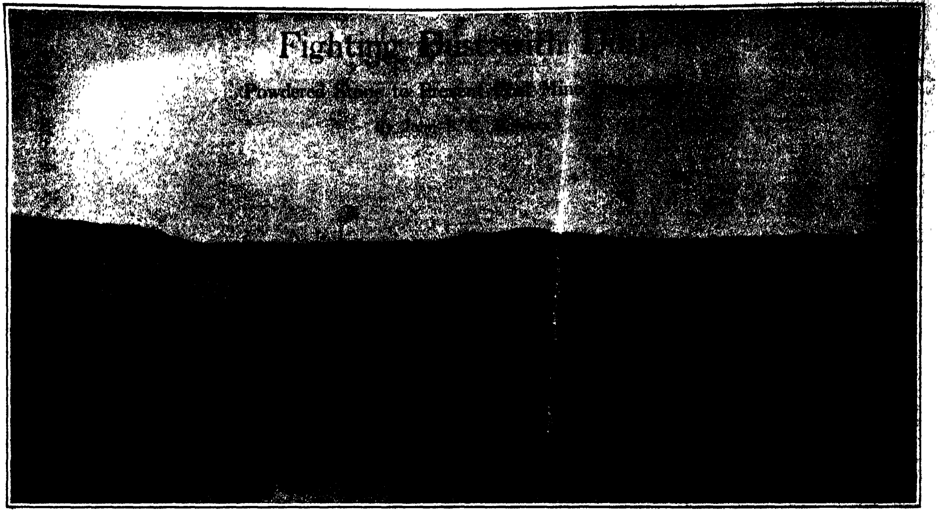
The advantage claimed for the biorisator process, as a substitute for the ordinary methods of pasteurization and sterilization, is that while it insures the destruction of pathogenic germs, it produces no change whatever in the chemical composition of the milk. The latter retains all the properties of raw milk, and can be used for cheese making, besides keeping much longer than either raw or pasteurized milk.

The essential features of the process are that the milk is poured into a pressure chamber, where it is subjected by a pump to a pressure of 4 atmospheres; it is then conveyed by the same pressure to a large cylindrical vessel, which it enters in the form of a fine spray, and is, at the same time, subjected to a temperature of 167 deg Fahr From the cylinder it passes through a cooler, where its temperature is rapidly lowered to at least 50 degrees From this it flows to a bottle-filling machine The peculiar merit of this process appears to be that the milk is subjected for only a brief time to the sterilizing temperature while in the form of a spray Another advantage is that no milk is lost by evaporation.

Fighting Dust with Dust

Powdered Stone to Prevent Coal Mine [illegible]

By [illegible]



General view of the Experimental Explosion Station, showing the 7½-foot gallery.

THE SCIENTIFIC AMERICAN SUPPLEMENT of August 23rd last, contained the reprint of a paper upon the "Effects of Incombustible Dusts on the Explosion of Gases," read by Prof. Harold B. Dixon, F.R.S., and Colin Campbell, M.Sc., before the Manchester (Eng.) section of the Society of Chemical Industry. The investigations described in this paper had their origin in the proposal to use stone or slate dust in coal mines, in order to minimize or prevent the dangerous explosions of coal dust, which have been proved to add greatly to the devastating effects of fire-damp explosions in dry and dusty mines. The objection had been raised (based on some experiments carried out by Sir Frederick Abel in 1881-1882) that incombustible dust such as stone or slate dust would *add to*, rather than *minimize* the dangers of explosion in mines, because catalytic action would come into play, and would accelerate the rate of the chemical combustion of the carbon-monoxide or methane with the oxygen of the air.

The investigations referred to by Dixon and Campbell proved *conclusively that* Sir Frederick Abel had drawn wrong conclusions from the results of his experiments in 1881-1882, and that *the presence* of incombustible dust in a mine, so far from accelerating the rate of combustion, exerted a cooling and quenching effect on the flame. The use of such dusts in coal mines cannot therefore add to the danger or intensity of fire damp explosions.

Since Dixon and Campbell's paper was published, the fifth report of the Explosions in Mines Committee has been published,[1] and as this contains very important recommendations and proposals regarding the use of stone dust in mines, certain of the "*conclusions*" arrived at by the committee are given below

"A slowly traveling inflammation, such as is produced when a ready made dust cloud is ignited by a large jet of gas (unaccompanied by concussion) is at first capable of licking up coal dust deposited upon the *surface of an* incombustible dust and propagating itself for some distance until sufficient violence is developed to raise the incombustible dust also, and this raising of the incombustible dust is more readily effected when a lighter or more buoyant dust, such as flue dust or fuller's earth, is employed, both coal and incombustible dust being raised in suspension together, and the flame soon dying down"

. . . .

"Incombustible dust is more effective in preventing the ignition of coal dust than in checking an inflammation that has started. It should, therefore, be distributed uniformly throughout those galleries of the mine subject to the danger of coal dust ignition, and if maintained in the proportion of between one and two parts by weight of incombustible dust to one of coal dust, the chances of such ignition taking place would be very small. Even a small proportion of incombustible dust (20 or 30 per cent by weight) has a marked effect in checking an incipient inflammation.

"The disposal of incombustible dust in zones, or in easily disturbed masses concentrated in certain positions, *leaving portions of the roads untreated, is, we think, not likely to be effective.*

"In the case of mild inflammation, an incombustible dust that is readily raised and floats in the air, has been found to be more effective than one which, owing to its shape or density, is less buoyant.

"Shale dusts, or even heavier dusts, such as sand, are, however, effective, when sufficient violence has been attained to raise them in suspension in the air."

Having thus formulated the conclusions, which appear to follow from their experiments at Eskmeals and elsewhere, the committee make some practical suggestions, and here again it will be best to quote their report:

"It must be distinctly understood that our experiments have traversed, as yet, only a portion of the subject, and that what we propose is advanced as a provisional precaution which may be found on further experience to need extension. But since these experiments have clearly shown the great difficulty of initiating an explosion in a gallery where the coal dust has been mixed with an easily raised incombustible dust, so that the mixture contained at least 50 per cent of incombustible material, we are confident that the dust in a mine so treated would be relatively safe from ordinary ignitions, and consequently that the chance of a *disastrous explosion would be greatly diminished.*"

. . . .

Since this admixture with 50 per cent of incombustible matter, which can be carried out in a simple and practical way, confers on coal dust such power of resisting inflammation, it might be, in our opinion, most *usefully adopted now, even if further experiments may lead to extensions, or other methods be found more efficient.*

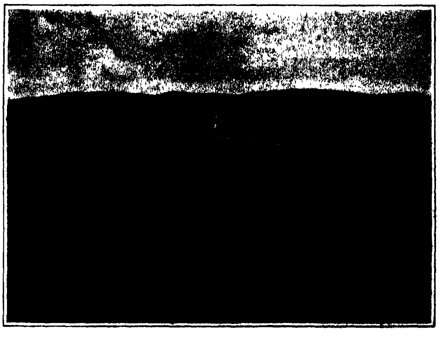
We think therefore that, as an alternative to watering, the treatment of coal dust by an incombustible dust—so as to maintain an excess of incombustible matter in the mixed dust—might be adopted as fulfilling the requirements of the English Coal Mines Act of 1911.

By Section 62 (3) and (4) of that Act it is enacted that:

"The floor, roof and sides of the roads shall be systematically cleared so as to prevent, as far as practicable, coal dust accumulating; and . . . systematic steps, either by way of watering or *otherwise* . . . shall be taken to prevent explosions of coal dust occurring or being carried along the roads. Such a systematic step

(*Concluded on page 294.*)

Free end of the gallery during a test.



Junction of the 7½-foot gallery with one 3 feet 2 inches in diameter.

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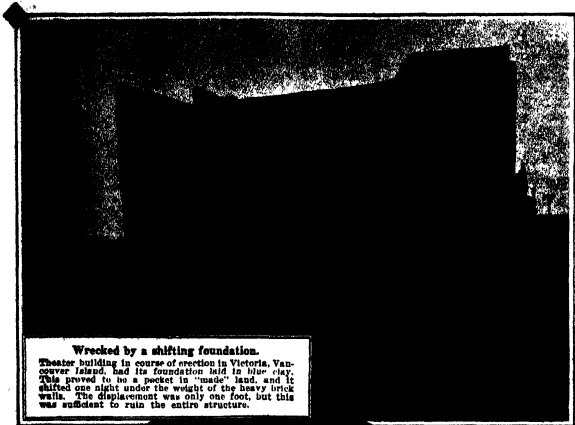
[1] Cd. 7,132. Date, October 22nd, 1913.

Curiosities of Science and Invention

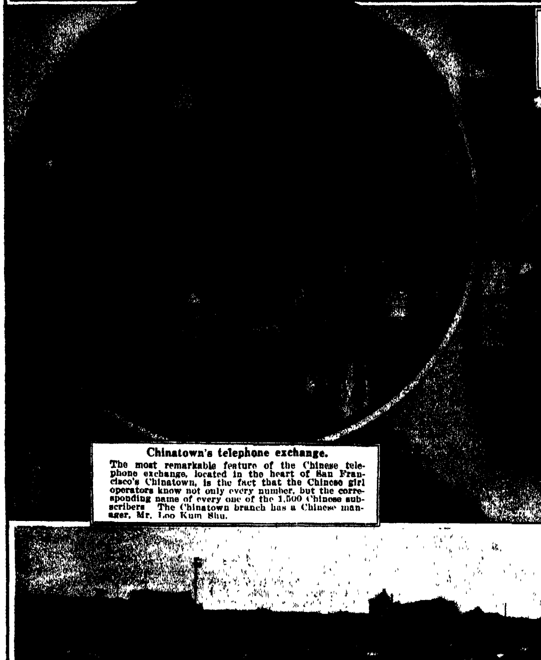


Wrecked by a shifting foundation.

Theater building in course of erection in Victoria, Vancouver Island, had its foundation laid in blue clay. This proved to be a pocket in "made" land, and it shifted one night under the weight of the heavy brick walls. The displacement was only one foot, but this was sufficient to ruin the entire structure.

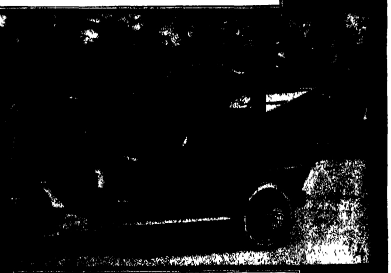
Motorcycle chemical fire-engine.

There has recently been developed in Oklahoma City a novel emergency fire-engine, consisting of a regular motorcycle equipped with two chemical tanks on either side of the rear wheel directly back of the driver's seat. This equipment can be brought into action more quickly than an automobile fire-engine.



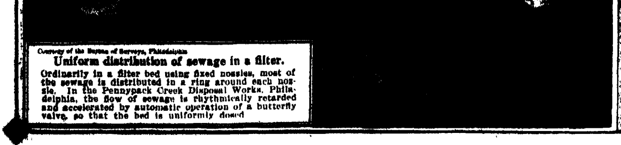
Chinatown's telephone exchange.

The most remarkable feature of the Chinese telephone exchange, located in the heart of San Francisco's Chinatown, is the fact that the Chinese girl operators know not only every number, but the corresponding name of every one of the 1,500 Chinese subscribers. The Chinatown branch has a Chinese manager, Mr. Loo Kum Shu.



Front drive tricycle motor car.

The idea of using a front drive in motor cars dates back to the very earliest days of the automobile, when efforts were made to use the motor in front of the vehicle as a substitute for a horse. Now, apparently the idea is being revived, as may be noted in the recent photograph.



Courtesy of the Bureau of Surveys, Philadelphia

Uniform distribution of sewage in a filter.

Ordinarily in a filter bed using fixed nozzles, most of the sewage is distributed in a ring around each nozzle. In the Pennypack Creek Disposal Works, Philadelphia, the flow of sewage is rhythmically retarded and accelerated by automatic operation of a butterfly valve, so that the bed is uniformly dosed.

Slot machine for the job seeker.

A Los Angeles inventor has installed a "job seeker's" slot machine on the streets. The glass case shows cards stating conditions offered by employers. Dropping a quarter in a slot releases the corresponding card, which bears the employer's address on the back. If he finds the job taken, the quarter is refunded by the firm operating the machine.

ODDS AND ENDS FROM THE EDITOR'S DRAWER.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Pertaining to Apparel.

WAISTBAND LINING FOR TROUSERS.—A A BROWN, care of A. L Palmer Co., 818 Lafayette St N Y, N Y By means of this invention linings of trousers are sewed entirely by machine thus doing away with the necessity of placing the work outside the factory, in homes as is the custom. These advantages accrue from a novel construction of waistband lining which can be quickly made and attached to the garment, and at the same time present a neater appearance than do waistbands sewed to trousers by hand.

TAILOR'S RULE —M. CARROLL, 196 Madison St, New York, N Y This invention relates particularly to rules for tailors' use and for ruling off garments or patterns, and it provides a structure in which the various measurements have been arranged in systematic order so that a proper pattern may be cut with a minimum amount of measuring

ARCH SUPPORT FOR SHOES.—P. IACOVINO, 199 Prince St., New York, N. Y. An object here is to provide a support which may be applied to any footwear and at any time. The support is provided with suitable bracing members for supporting the arch of the foot, the entire structure being also formed so as to be readily inserted in a shoe after its completion

Electrical Devices.

ELECTRICAL FURNACE —C. C. WHITMORE, 104 E First St, Butte, Mont. The advantages in this case are The utilization of the current in two ways, to wit, in heating electrodes and in heating ores and substances intermixed therewith by conductivity thereof To prevent overheating of electrodes To control distribution of ores or other materials upon which the furnace operates, a greater amount of material being passed into the furnace at points where the heat thereof is comparatively great. To enable a group of electrodes to be readily removed relatively to another group thereof for purposes of distributing the current

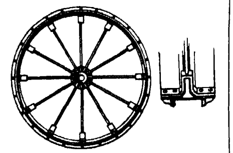
SIGNALING DEVICE FOR PARTY LINE TELEPHONES.—T. KERNAN, 428 Fifth Ave., N E. East St. Cloud, Minn The improvements in this case indicate to a user of the telephone whether a person other than the party with whom he desires to talk has taken down or put up his receiver, and also indicates the identity of the party who is listening in. It may readily be attached to instruments of the ordinary type without interfering with the circuit

Of Interest to Farmers.

AUTOMATIC HOE —A THOMPSON, 122 Jefferson St., Spartanburg, S C. This invention relates to agricultural machinery, the more particular purpose being to produce a hoe having a number of advantages and adapted for use in a variety of different relations, being of special service in connection with the cultivation of cotton

BEET BLOCKER —H. W GRIBLER and A. G. GRIBLER, 741 Prospect Ave, Van Wert, Ohio. The purpose here is to provide a beet cultivator especially adapted for cultivating beets in the field in the opposite direction from the direction of the beets in the row, and wherein mechanism is provided for protecting the plants during the cultivating operation

TRACTION WHEEL FOR PLANTERS.—E. J OGDEN, Springfield, Ill This application is a division of the application Serial No 664,000, filed Dec 5th, 1911, patented Nov. 25th, 1913, No. 1,079,797, and the invention relates to traction wheels for corn and other planters



TRACTION WHEEL FOR PLANTERS

The object of the present invention is to provide a wheel with means which will straddle the hills of corn or other seed, or which can be made a traction wheel by closing the space between the ribs as shown in the smaller engraving A further object is to provide a wheel with means which will effectually prevent it from slipping

STRAW STACKER —J MASERANG, 6653 Manchester Ave., St Louis, Mo The object here is to provide a stacker of the blower type, wherein mechanism is provided in connection with the stacker for permitting straw as it issues from the stacker to be directed to any parts of the stack, the said means being operated from the threshing machine

ELEVATOR.—E. H. ZIMMERMAN, P. O Box 67, Perry, Ill. The purpose here is to provide an elevator which may be transported from place to place and may be operated from any suitable source of power, and which is especially adapted for handling grain, such as corn and wheat, vegetables, such as potatoes or any other article that can be handled with a scoop shovel.

EVENER.—R. H. KEITH and F. H. BROOKS, Rowan, Iowa. Address the former. The patent provides a device especially adapted for use with farming implements of the drag class, especially of the folding type, and so arranged that the evener may be folded with the drag, in passing through gates or narrow passages.

Of General Interest.

SHAVING BRUSH.—H. ROBINSON, 1 First Ave., Winfield, N Y The principal object here is to provide a collapsible handle having a tubular portion to form a pocket for the brush tuft, and to construct the handle or mounting to form a box like casing, the ends whereof are closed to prevent the admission of dust to the tuft and to prevent the tuft moistening surrounding surfaces.

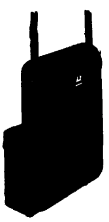
HOLE CLOSURE.—D. J. DIEL, 3614 Rockaway Road, Woodhaven, L I., N. Y Among the objects particularly aimed at is to provide a cheap reliable metal closure which may be quickly secured in place, substantially closing the hole or opening, but which may be removed with facility by a suitable simple tool, when necessary, for reopening the hole

ANVIL ATTACHMENT.—J R STULL, 1121 South Los Angeles St, Los Angeles, Cal This invention provides an attachment for an anvil having an arm, which extends through an opening in the top of the anvil, the arm being provided with a head, which projects longitudinally of the anvil at opposite sides of the arm, the last being pivoted to a lever, fulcrumed to the anvil block, so that this lever may be operated by the foot of the smith, to conveniently clamp the member between head and anvil

OPTICAL INSTRUMENT — W WORK, care of H. S. Hewett, 119 Main St., Brockton, Mass. The inventor provides an instrument to be used in conjunction with a plano retinoscope, and arranged to permit of quickly and accurately determining the amount of refraction of the eye of a patient under observation by an oculist or other examiner, to insure fitting the patient with eyeglasses or spectacles having correct spherical, cylindrical or compound lenses.

ELEVATED CARRIER —F. L PUTNAM, Lihue, Hawaii This invention pertains to elevated carriers and has particular reference to apparatus adapted for various uses such, for instance, as gathering various commodities over a field or wide scope of operation, and conveying the same to a distant point for delivery or deposit

COMBINED CAMERA CASING AND FILM CARRIER —R R LIVINGSTON, Clermont, N Y. This invention relates to photographic cameras using roll films, and its aim is to provide a combined camera casing and film carrier arranged to permit carrying extra films without increasing the size of the camera casing, and to allow convenient removal of a roll film from the film carrier whenever it is desired to use such film in the camera or for storing the exposed roll film in the carrier.



COMBINED CAMERA CASING AND FILM CARRIER.

AUTOMATIC CLOSURE DEVICE FOR LUBRICATORS —F BLED, Versailles, Seine et Oise, France The characteristic qualities of the apparatus consist in the features that the operations of opening and closing are very rapid, that it completely uncovers the lubricating orifice, that it is absolutely tight, and that by reason of its method of fitting it prevents the entrance of dust when it is open and that, moreover, no throwing-out of oil takes place when it is closed.

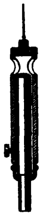
PROCESS FOR MAKING PHOTO STEREOTYPES FOR TYPOGRAPHIC PRINTING PRESSES —C BAECHLER, Lompoc, Cal. In this instance the invention has reference to the process of making printing blocks directly from any negative or film, by employing bichromated gelatin or glue, and a screen or chemical grain to form the printing block.

OPERATING TABLE FOR USE IN ANIMAL RESEARCH —KATHARINE STEBBINS, 437 W 59th St, Manhattan, N. Y, N Y The table is constructed with posts having hooks at their upper terminals, which engage eyes of adjustable leaves which rest on cross-bars supported on screws which mesh in threaded openings in the table, so that by turning the screws the cross-bars may be raised or lowered, carrying with them the leaves. The sides of the leaves are curved over the lugs, which permits the movement of the leaves without interference by the hooks on the posts.

WIRE FENCE STRETCHER.—T. R. G. SMITH, Warren, Ark. In this invention use is made of a jack screw operated by a T-handle similar to the handle of the common bench vise, and an elongated tubular base that is threaded internally to secure the jack screw, and bears against the post to which the fence wires are to be secured. The wires are received in and gripped by a standard, which is connected with the jack screw through the medium of a yoke that is adjustable to different heights on the standard, and is swiveled to the jack screw.

COLLAPSIBLE TRUNK.—B. L. URDANG, 11a W 118th St, New York, N Y. Among the special objects of the invention is to produce a trunk so as to be strong, rigid and durable in use for shipping or storing purposes and adapted to be collapsed when empty and with all of the parts substantially inclosed between the bottom and the lid.

BURGLAR ALARM.—J. HOFMANN, 157 E. 55th St., Manhattan, N. Y., N. Y. Use is made of a barrel having a closed upper end forming an anvil against which a detonating cap is to be exploded, the barrel being adapted to be suspended from one end of a cord having its other end clamped in place by the movable object at the time the latter is shut, so that on opening this object the cord is released to allow the barrel to drop. Use is also made of a screw cap and a firing pin slidable in the barrel and screw cap and projecting below the screw cap, the pin being adapted to carry a detonating cap to be exploded against the upper end of the barrel at the time the barrel drops and the pin strikes the floor.



BURGLAR ALARM.

HORSESHOE.—G STAPLES, Oshkosh, Wis The present invention relates to horseshoes and is an improvement in that class of horseshoes provided with a resilient cushion or pad and with removable calks, the object being to provide certain novel details in the construction and arrangement of the several parts.

REFRIGERATING APPARATUS.—W. A. OWEN, Johnson City, Tenn. In carrying out the present invention, it is the inventor's purpose to provide a refrigerating apparatus whereby articles or eatables such as meats and the like of a perishable nature, may be kept cool and by means of which the operation of making ice may be carried on.

SUPPORT —W A POWEL, 108 E Main Cross, Taylorville, Ill The support is designed for holding the pipe sections of the water main in position in the trench for conveniently joining adjacent sections, and for pouring the lead into the bell or spigot joints a distance above the bottom of the trench to avoid cutting bell holes for leading and calking purposes, the support being arranged to permit of gradually lowering the united pipe sections to their final resting place in the bottom of the trench.

HORSESHOE CALK —F F. HEISELMANN, Cox Place and Edwards Rd., Hyde Park, Ohio This invention refers more particularly to the combination with a horseshoe provided with a recess, of a calk having a point and a head adapted to be received in and fit into the recess, and a keeper co-operating with the calk and recess of the horseshoe to secure the calk against accidental displacement

BASKET.—M. J WHEELER and F. B FOSTER, Peterboro, Hillsboro Co., N. H. This improvement relates more particularly to a fruit or vegetable basket, and it is a design of the invention to provide a basket by which the fruit or vegetables may be handled and dumped from the basket without injury and with convenience.

POST OR POLE —J M. BOOTH, care of Evans State Bank, American Falls, Idaho. The object in this instance is to provide a metallic post which may be quickly and economically formed, which will effectually receive and hold longitudinal fence wires and thus be adapted for use as a fence post, and which may be driven into the earth and rigidly maintain itself in position

SHAVING CREAM.—P C MAGDLEN, 63 W. 107th St., New York, N. Y. The object in view is to provide a composition adapted to be used on the face in place of an ordinary shaving soap, which will soften the beard and allow the razor to be used in the usual manner while combining with such characteristics the usual characteristics of a good quality of face cream.

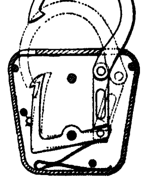
METHOD FOR LOCATING THE PLACE AND CHARACTER OF A LIQUID COMING FROM STRATA IN A WELL.—T. A. BEECHER, Box 352 Drumright, Okla. The object here is to determine and locate strata containing liquids when drilling a well or in a drilled well. The inventor employs proper coloring matter, placed in a predetermined position in the well, and then the liquid from the well is gradually discharged and analysed to ascertain if the so discharged liquid contains the coloring matter. Mr. Beecher has invented another method in which he employs proper coloring matter diffused in a predetermined place in the well, then displacing the colored liquid from the well, and then getting samples of liquid from different depths in the well and ascertaining if the samples contain any of the coloring matter diffused.

PROCESS OF MANUFACTURING COMPOSITIONS OF MATTER.—L. LILIENFELD, Zeltgasse 1, Vienna, VIII, Austria-Hungary. This invention relates to improvements in the process of manufacturing compositions of matter by means of heating a drying oleaginous substance with an aromatic substance in the presence of a condensing agent, as described in the applicant's prior patent, No. 1,037,158.

LETTER BINDER.—C. E. O'NEILL, care of First National Bank, Butte, Mont. An object here is to provide a binder of any suitable size which is adapted to embrace all of the sides and ends of the package, and which automatically accommodates itself to the size of the package, making it easy for the binder to be manipulated for the purpose of receiving or delivering letters on other parts to or from the package.

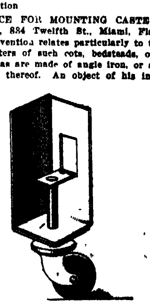
Hardware and Tools.

PADLOCK.—J. SUKUP, 603 Munkivitz Ave., Cudahy, Wis. The padlock represented in the engraving is one difficult of manipulation for opening, except by one familiar with its construction and operation The padlock may be unlocked by manipulating the shackle from the outside, but may not be unlocked by a key or other instrument, the lock, however, being provided with a key hole so as to present the appearance of an ordinary padlock and thus mislead unauthorized persons attempting to pick the lock, into believing it to be one of usual construction



PADLOCK.

DEVICE FOR MOUNTING CASTERS.—C. J. BELL, 884 Twelfth St., Miami, Fla. Mr. Bell's invention relates particularly to the legs and casters of such cots, bedsteads, or other articles as are made of angle iron, or at least the legs thereof. An object of his invention is to provide caster bearings formed integrally with the sides of the angle iron legs, thereby to provide a simple and strong construction. The engraving gives a perspective view, showing the lower portion of an angle iron leg embodying the improvement



DEVICE FOR MOUNTING CASTERS.

WRENCH.—W. CARMAN, 6 Liberty St., Ellenville, N. Y. This invention has reference to a wrench of the quick-acting type, wherein a movable jaw is locked with respect to the shank or handle bar by a pawl or toothed lever which is held in engagement with the teeth on the [illegible] during use of the wrench.

MORTISE LATCH AND LOCK.—A. C. [illegible], 277 Rider St., Bronx, N. Y. In the present invention the object is the provision of a new and improved mortise latch and lock, more especially designed for use on fireproof swing doors and hollow metal casings, and arranged to provide multiple locking contents in a simple and effective manner.

SAW SET AND JOINTER.—A. DUDGSON, 617 Spring St., Latrobe, Pa. This inventor provides a saw set and jointer which will set a number of teeth at a time, in which the tooth bit can be set at different sizes of saw teeth, and in which the motion of the setting tool is adjustable and which, also, is adapted to receive a file for jointing the saw.

PENCIL SHARPENER.—O. W. NIEDOMANSKI, 721 Rock Creek Road, Washington, D. C. This improvement has reference to pencil sharpeners of the type suitable to be carried in the pocket and easily handled, the more particular purpose being to increase the efficiency of the sharpener while promoting the simplicity of the construction thereof.

Heating and Lighting.

MECHANICAL MATCH LIGHTER.—E. D. FITZPATRICK, 408 Paxton Block, Omaha, Neb. The inventor provides a time-released mechanism to ignite a match by abrading the head thereof; provides an alarm clock with means for lighting a match by abrasively engaging the head thereof; and provides a clock mechanism with means for holding a match in operative position, and with means for igniting the same by abrading the head thereof when released by the clock mechanism.

FUEL APPARATUS.—J HYDE, deceased, care of Catherine Hyde, administratrix, 315 Summit Ave., Mt. Olive Station, Pitt, Pa. This invention relates to apparatus for adapting coal and other like fuel for efficient combustion in a finely divided state, admixed with air, and it refers more particularly to apparatus of the class described, which comprises a casing having a fuel inlet and an outlet, a rotary comminuting device in the casing, and a blower for drawing air in the casing, and forcing the fuel mixture through the outlet.

Household Utilities.

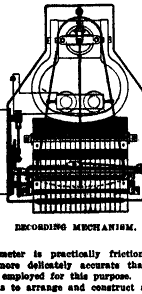
BED COOLER OR HEATER.—G. F. SHEPPARD, Box 51, Dodge City, Kan. This device is formed of a pair of similar receptacles having ordinarily the length of an average human body, which can be positioned longitudinally, or otherwise, in a bed, each of said receptacles having means whereby it can be made a cooler or a heater.

Machines and Mechanical Devices.

VIEW CHANGING DEVICE.—W C. UPP, 30 Church St., New York, N. Y. This invention has reference to view changing devices and has particular reference to means for exhibiting cards, pictures or the like, in such manner as to provide an automatic change from one view to another at regular intervals

THREAD CUTTING ATTACHMENT FOR SEWING MACHINES.—R. L. COLEY, Kannapolis, N. C. Address J. W. Cannon, Concord, N. C. The purpose here is to provide a mechanism adapted for connection with certain types of sewing machines, for automatically clipping the thread between succeeding pieces of work, as each piece is completed, and wherein means is provided for retaining the operation of the cutter during the passage of the work beneath the needle.

RECORDING MECHANISM—H W. PAYNE, 65 Hobart St., Rochester, N Y This invention relates to recording mechanism designed especially for recording delicate and accurate measurements or quantities such as volts An object is to improve this class of devices whereby the operation thereof with respect to the galvanometer is practically frictionless, and hence more delicately accurate than devices usually employed for this purpose. A further object is to arrange and construct an instrument which is adapted for making variable records upon a chart having rectangular coordinates whereby such records are more easily and reliably read than when made on other forms of charts.


RECORDING MECHANISM.

FRICTION CLUTCH.—N. J. WIGGINTON, Winchester, Va. This improvement provides a friction clutch which will transmit to a machine a given amount of power, and which, when the load on the machine increases beyond a certain point will turn idly, thereby obviating any danger of injury to the machine, such as might occur if the clutch were not used.

ELEVATOR INDICATOR.—F. A. BORDTCHER, Bergenfield, N. J. This invention is adapted to automatically operate for indicating not only the floor at which the elevator may be positioned and the progress of the elevator from one floor to the other, but to indicate the direction of travel of the elevator regardless of whether or not the same is moving or stationary, so that a person looking at the indicator may observe whether the particular elevator is making an up or down trip.

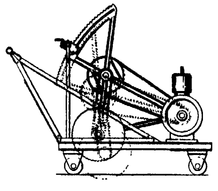
RESUSCITATING APPARATUS.—C. M. HAMMOND, Memphis, Tenn. This inventor provides a casing which may be placed over the body of a patient, and through which the arms, neck and legs may project. This casing forms an air space which may be relieved of the external air pressure, thereby causing the air within the lungs to expand and a rush of air through the air passages into the lungs, similar to the movement of air caused in natural breathing.

ADJUSTABLE CRUSHER HEAD.—E. L. PEMBERTON, 15 Livingston St., New Haven, Conn This invention relates to crusher heads which may be used for rock and other similar crushers, and which are customarily mounted on a main shaft. These heads are usually manufactured from cast manganese steel to provide the necessary hardness, but as crusher heads when made of this material work loose on the shaft, the present improvement provides means for adjusting and tightening the crusher head on the shaft from time to time.

PUMP CYLINDER.—L. G. EDDY, Huntington, N. Y. In this case use is made of a sleeve extending into the lower end of the pump cylinder and provided at its lower end with a screw thread, a screw, a coupling removably connected with the sleeve, and a packing on the sleeve intermediate the said pump cylinder and the said coupling.

MEASURING MACHINE.—A. F NIMS Philadelphia, N Y The purpose of the invention is to provide a machine by means of which the respective positions of the mixtures can be easily regulated, and in which obstructions or bodies too large to pass through a hopper are automatically removed without injury to the machine.

MACHINE FOR CUTTING PAVING.—G. PERKINS, 511 E St., N W., Washington, D C. This invention relates to a machine for cutting asphalt and other paving through the use of a power-driven circular saw, the object being to provide a machine including means by which to support a circular saw in such manner that it may be adjusted toward and away from the ground and held in selected position for cutting the paving or other material to a desired depth


MACHINE FOR CUTTING PAVING.

ILLUMINATED CLOCK—A MORINA, 122 Stone St., Newark, N J. To illuminate a clock, this inventor arranges a holding means for a small lamp, and a chamber between the clock works and the dial. A side door affords access to the lamp chamber. An extinguishing device is actuated at a predetermined hour by an adjustable trip, turning with the hour hand arbor.

LOOM FOR WEAVING ORIENTAL KNOT PILE FABRICS—J. K DALKRANIAN, care of M. N. Costikyan, 200 Fifth Ave., Manhattan, N. Y., N. Y This invention relates to pile fabric looms such as shown and described in the application for Letters Patent of the U. S., No. 265,886, filed by Mr. Dalkranian on June 19th, 1905. The object is to provide a pile fabric loom more especially designed for weaving pile fabrics of the oriental rug type, and preferably such having Persian knots and a reinforced body, as shown and described in the application for Letters Patent of the U. S., No. 312,143, filed by this inventor April 17th, 1906.

POPCORN VENDING MACHINE.—G. A. LIGHTNER, Olustee, Okla This invention relates more particularly to a vending machine in which fresh corn is fed to the heated popping drum, popped for a predetermined time, salted, and delivered to the purchaser in a definite sequence of operation, all of the mechanisms being actuated by a coin-controlled device.

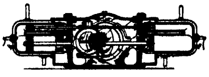
ATTACHMENT FOR ALARM CLOCKS.—E. H. PRATT, Lompoc, Cal. The object of this invention is to provide such releasing means as may be wholly mounted on the exterior surface of the clock without necessitating ingress or connection within the same, which is brought into operation by a friction clutch member disposed upon an exterior portion of the alarm winding arbor and adapted to engage the same when it is turned in one direction only.

HUB-FACING ATTACHMENT FOR CAR WHEEL BORING MILLS.—F. V. MCDONNELL, care of M. P. Lines, W. of Pittsburg, Logansport, Ind. The general object of the invention is to provide an attachment whereby the feed screw for the facing cutter can be power-driven so as to relieve the operator of the work of turning the screw, it being merely necessary for the operator to initially adjust the facing cutter and then interrupt the feed of the latter when the cut has been completed.

Prime Movers and Their Accessories.

ENGINE—J. H. RICHARDSON, Verdon, Neb. The purpose here is to provide an engine for utilizing the expansive force of fluids, wherein a series of pistons is provided, the central piston moving between the lateral pistons and in opposite direction to the said pistons, and cooperating in alternation with the said pistons as an abutment against which the motive fluid may react.

INTERNAL COMBUSTION ENGINE.—J W. PITTS, Hotel Stratford, Houston, Tex. This invention provides novel means for ridding the cylinders of the spent gases or products of combustion and for cooling the cylinders It provides means for doing away with the back pressure on the exhaust, and this is accomplished by means of a device which makes use of the momentum acquired by the gases themselves. It provides a device whereby a plurality of pistons may be connected to work absolutely in unison, and provides a novel form of compression chamber for the explosive charges


INTERNAL COMBUSTION ENGINE.

STARTING DEVICE FOR INTERNAL COMBUSTION ENGINES.—D. E CROUSE, 3 North St., Annapolis, Md. An object of the present invention is to provide a device which may be started from any point by the mere compressing of an electric push button, the subsequent operation of the device serving to start the internal combustion engine and to restore the starting mechanism to its normal position

Railways and Their Accessories.

BOILER WASHING SYSTEM.—W. M. SAXTON, Spokane, Wash, and C C HODGE, Winnipeg, Manitoba, Canada Address the former, 46 Canada Life Building, Spokane, Wash This invention provides means whereby the boilers of a plurality of locomotives, each under a different steam pressure, may be blown off simultaneously without one interfering with the other, and any member may be washed out at the same time.

SWITCH STAND LOCK—C WOOD, P O Box 331, Moulton, Iowa. This device is capable of being applied to existing stands without radical change, by means of which the dropping of the lever into inoperative position after setting the switch to either position will positively lock the switch, that is, will lock the operating lever to the stand Mr Wood has invented another switch stand lock which provides means in connection with a switch stand for locking the operating lever to the stand, with the switch in open or closed position, wherein the locking means is actuated by the dropping of the operating lever into inactive position

SAFETY SWITCH POINT—J B COBB, JR., 611 N Chapman St, Shawnee, Okla This invention is an improvement in safety switch points, and has for its object the provision of a switch point of the character specified, wherein the points will be at all times held in normal position regardless of defects in the switch, stand, or the connecting rod

Pertaining to Recreation.

TOY—E LOGAN, 1900 Kater St, Philadelphia, Pa. This toy is adapted to be trundled along the floor by a child, whereby it is adapted to give a succession of rings on a bell attached thereto. An object is to provide a device in which a bell may be sounded by movement of the same in one direction, and whereby said bell will remain silent by movement in the opposite direction.

CAROUSEL.—S W BRUNDAGE, care of Charles W. Parker of Leavenworth, Kan This invention provides useful improvements in merry-go-rounds or carousels whereby a pitching and rolling movement is given to a boat or similar vessel while being bodily carried around, so as to enable the occupant of the boat to enjoy a ride similar to that when aboard a pitching or rolling marine vessel on troubled or disturbed waters.

ANIMATED TOY.—A. GUND, 220 W 19th St., Manhattan, N. Y., N. Y. This invention provides a toy in doll form or simulating an animal, and is arranged when alternately pressed and released to actuate certain members of the body, such as arms, legs, wings, or the like, and at the same time cause the production of sounds similar to those emitted by the simulated child or animal.

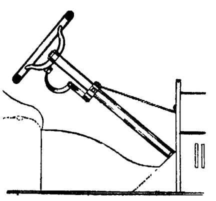
Pertaining to Vehicles.

LOCK FOR AUTOMOBILES—J. A. CAMPBELL, Carbondale, Ill The object here is to provide an automobile with a lock, the lock having a bar with a lug which may be moved into engagement with a lug on a foot pedal arm for operating the clutch, so that when the bar is secured with its lug engaging the lug on the arm it will be impossible to drive the automobile

SAFETY ATTACHMENT FOR AUTOMOBILE CRANKING MECHANISM—H C TUNIS, 54 Wakeman Ave, Newark, N J This invention provides means whereby is rendered impossible the ignition compression in engines of automobiles, while the speed gears thereof are in service position, and provides a simple and efficient mechanism for effecting the above stated operation

TIRE UPSETTER AND SHRINKER—J F BOYD, Box 25, Bigelow, Ark This improvement comprises a pair of upsetting blocks mounted to be moved toward and from each other, which carry gripping means for engaging the edge of the tire to crowd or compress the body thereof together, and thus reduce tire circumference to the required extent, and fit more tightly on the wheel The blocks are positively operated to be moved toward each other to cause the grips to perform the compressing operation, and means are also provided to return them after the operation of gripping, to their original positions

AUTOMOBILE LOCK—T S KEFFER, 22 N Raleigh Ave, Atlantic City, N J. The purpose here is to provide a lock for use in connection with the steering wheels of automobiles and other motor vehicles for preventing movement of the steering wheel by unauthorized persons, which may be applied to the steering wheel of any motor vehicle, without change in the wheel itself, and which when in operative position will absolutely prevent movement of the wheel, and when in inoperative position will not interfere with the operation of the wheel


AUTOMOBILE LOCK.

Designs.

DESIGN FOR A SANITARY TELEPHONE MOUTHPIECE—C MUNDT, 832 Willow Ave, Hoboken, N. J In this ornamental design for a sanitary telephone mouthpiece, one figure is a front view of a telephone mouthpiece, another is a rear view of the mouthpiece, and the last is a vertical section through the mouthpieces, part of a telephone being shown in dotted line

DESIGN FOR A TICKET BOOTH—W YAEGER, care of Strauss & Co, 209 W 48th St., New York, N Y In this design for a ticket booth the structure presents an elevation of exceptionally pleasing appearance Above the base a columned center supports a dome of highly ornamental design, which is crowned by a sphere.

DESIGN FOR A BUST REDUCER BRASSIERE S H BURNS and C D PERILLAT, "Ye Lady's Outfitterie," 15 W 38th St, New York N. Y In this ornamental design for a bust reducer brassière, Fig 1 is a front view in perspective; and Fig. 2 is a rear view

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NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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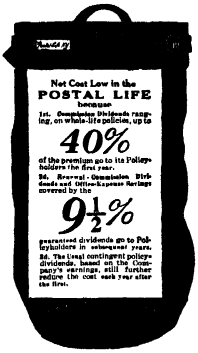
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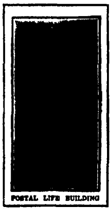
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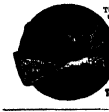

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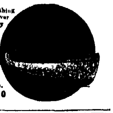

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Fighting Dust With Dust

(Concluded from page 290.)

as is laid down in the above clause would be taken, in our opinion, if the roads were treated with incombustible dust.

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In closing this brief account of the present position in the United Kingdom with regard to the use of stone dust in mines, a few particulars of the Experimental Explosion Station at Eskmaels, in Cumberland, may be given, also some details of the constitution of the committee in charge of the experimental work.

The experiments were commenced by the Mining Association of Great Britain, at Altofts Colliery, Normanton, Yorks, in 1908. The result of these experiments was to prove beyond all doubt the truth of the theory that coal dust suspended in the air was capable of being ignited without the aid of any inflammable gas, and was, therefore, capable of propagating an explosion through the dusty galleries of coal mines.

The official record of these experiments, and of the conclusion based upon them, is contained in the *Proceedings* of the Mining Association of Great Britain, for the year 1910. In that year, the Mining Association approached the Royal Commission on Mines with the view of ascertaining whether the government would be prepared to continue the experiments at the public cost, and offered to lend to the government the experimental plant and apparatus that they had accumulated at Altofts. This proposal was communicated to His Majesty's government, which ultimately undertook to find the funds necessary for the purpose An executive committee to carry out the experiments was appointed by the Secretary of State for the Home Department, consisting of Sir Henry Cunynghame, chairman; Mr R. A. S Redmayne, Capt A H P Desborough, Prof H B Dixon, and Mr W. C Blackett. The members of the Royal Commission on Mines, together with the Coal Dust Committee of the Mining Association already referred to, were constituted as a Consultative Committee The first meeting of the Executive Committee was held at the Home Office on May 11th, 1911.

The site at Altofts being no longer available, it became necessary to seek a new one. An endeavor was made to secure a suitable locality which should be at a fairly equal distance from the various coal fields in England, Scotland, and Wales, which should be remote from dwellings, and at the same time should be near a railway so as to afford convenient access for heavy material. After the examination of numerous sites a piece of land on the sea was chosen, near Eskmaels, in the county of Cumberland, adjoining the gun-range of Messrs. Vickers The works are surrounded by sand hills. The space available for a gallery measures 600 yards in length from the eastern side of the seashore. The large gallery (7 feet 6 inches) has been removed from Altofts, and has been placed east and west, so as to point seaward, and it nows extends to a length of 800 feet.

A smaller gallery, 3 feet in diameter and 400 feet long, has been fixed alongside the large gallery for the purpose of making comparative experiments, and the number of recording instruments for following the course of the explosions has been accordingly increased.

The writer's thanks are due to Prof. Harold Dixon, F.R.S., a member of the Home Office Committee, in charge of the experimental work, and also to Dr. Wheeler, the chemist in charge of the tests at Eskmaels, for their co-operation in obtaining photographs and information for use in this article.

The Water-drop as a Microscope

(Concluded from page 288.)

the lens, thus limiting the diameter of the hole, which can successfully be used to hold the drop, and the magnifying power of the lens possible with any given holder. The magnifying power may, however, be increased by using a smaller holder, since

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the surface of the drop will be sharper and the effect of gravity is lessened. Very small holders are to be avoided, especially in photographic work, as they let through too little light. Of course it is necessary to use the holder in a horizontal position.

The simplest and best type of holder is that shown in Fig. 2. It consists of a piece of metal about 1/32 inch thick having a straight round hole bored through it at the center. It is of paramount importance that the upper and lower edges of this hole be true circles. The easiest way to insure this is to drill the hole with a first-class twist drill, and then polish both top and bottom surfaces on a flat oil stone. If iron is used it should be blued afterward by heating, to prevent rusting. The best results with this type of holder are obtained with a diameter of from 1/16 inch (having a maximum magnifying power of 100 diameters) to ⅛ inch (having a maximum magnifying power of 60 to 70 diameters).

To fill the holder, a stick with a very long, slender point is best. Dip this stick in the liquid, shake off any surplus, place the point against the inner surface of the holder and allow the desired quantity of liquid to run in. Considerable care must be exercised to prevent any liquid from running over the surface of the holder, thus destroying the circular contact. No trouble will be experienced in this respect unless too much liquid remains on the stick, or its point is allowed to slip over the surface of the holder.

Fig. 3 shows the apparatus used in taking the accompanying photographs. It consists of a camera *A*, whose lens has been replaced by a wooden frame supporting the holder *B*, so arranged that the holder may be easily removed for replacing the liquid lens. The camera is supported on an upright *C*, fastened to the box *D*. Within the box *D* is a lamp *E* and the camera lens *F* so placed as to concentrate the light on the liquid lens in *B*. The adjustable platform for bringing the slide *H* into focus consists of the board *G* pivoted at one end and supported by the screw *S*. Focusing is accomplished by turning the screw *S*, which should be capable of a vertical adjustment of at least ⅛ inch, and should make it possible to bring the slide *H* nearly into contact with the liquid lens. The box *D* and the platform *G* have holes in them directly under the liquid lens to let through the light from the lamp.

The image of the specimen is projected by the liquid lens against the ground glass of the camera and sharply focused by turning the screw *S*. When this has been done, the camera is loaded in the usual way. An exposure of 5 minutes with an ordinary kerosene lamp burning half height will probably suffice.

In photographic work, instead of water, it is best to use a glycerin lens, as a glycerin lens will not change its focal length by evaporation, and is not easily shaken by small jars.

For use as a microscope, the apparatus shown in Fig. 4 is sufficient. *M* is a mirror, *L* is the lens holder, *P* is the adjustable platform for holding the slide, and is made like *G* in Fig. 3. The mirror is tilted so as to reflect the light from any source up through the slide. If much field is desired, the eye must be placed quite near the liquid lens.

With this simple apparatus the hairs on the edge of a fly's wing, the teeth on the edge of a blade of grass, wood cells, etc., are distinctly visible; in fact, this simply constructed liquid lens microscope is sufficiently powerful for the needs of most amateur naturalists.

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IN a statement before the Committee on Public Buildings and Grounds of the House of Representatives, Commissioner Ewing has many interesting things to say about the Patent Office building. In the first place, he points out that the Secretary of the Interior occupies about three fourths of the room in the basement and about one half of the rooms on the main floor, and suggests that if the Secretary of the Interior were removed out of the

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First Magnitude Stars

(Concluded from page 280)

suns. All these then are blazing orbs, of which the faintest, substituted for our sun, would flood us with twice its light, and the brightest with 10,000 times the same

While the sizes of the fixed stars cannot be measured because of their distances, some estimate of the same may be justified by the light which they possess, even while making due allowance for possible variations of surface brilliancy. In general we cannot but regard the first magnitude stars, as compared not only with earth, but even with the sun, as being giant worlds of the first order. Arcturus alone has been thought to have a diameter 100 times that of our sun, which in turn is 108 times that of the earth.

In the matter of distance, most of these stars are within that degree of proximity which enables them to yield a parallax, by reason of the earth's shift of position, from one side of its orbit to the opposite, every six months There are only about 300 such stars known Larger and brighter stars there probably are, so distant that they are dimmed by the enormous gap which separates them from us and leaves us ignorant as to how remote they really are. The nearest of all the stars, so far as measured, is the third of the first magnitude, namely, Alpha Centauri, which requires 4.3 years to send us its light, while our own sun's comes in 499 seconds, or about 8½ minutes. Sirius is twice this distance, and is the third nearest star to earth, to which its extraordinary brilliancy is to be referred, rather than to its size or inherent splendor, great as these doubtless are. Four of these are numbered among the twelve nearest stars to earth, namely, Alpha Centauri (first nearest), Sirius (third), Procyon (sixth), and Altair (twelfth), the latter requiring only 14 years to send us its light.

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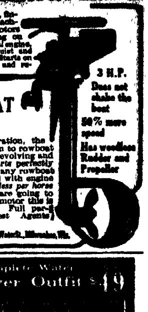
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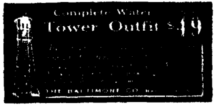

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[illegible] in space do we find surprising [illegible] 49 light-years for Capella, 90 for Regulus, 112 for Antares, then a strange and enormous gap to nearly or more than 500 for several others, including the magnificent Canopus. It seems strange that the twentieth star is much nearer than the second. What these distances mean is made clearer when we learn that, to travel to the nearest of all the stars, namely, Alpha Centauri, at the rate of 60 miles an hour, would require 49 million years, with an extra 100,000 years disregarded.

As for the location of these brilliant stars in the heavens, the reader is referred to the star atlases. Of the 15 seen by us northerners, 9 are visible in spring, 6 in summer, 6 in autumn, and 9 in winter. Only Rigel and Betelgeuse are found by northerners in the same constellation, namely, Orion, to whose extraordinary brilliancy they contribute not a little. The others are single gems in the constellations which they adorn.

It should be added that eight of these first magnitude stars have companions, whose brilliancy alone runs from 1/2,000 that of our sun in the case of Procyon's companion, and 20 times that of the sun in the case of Rigel's, to 200 times the same in the case of Beta Centauri's, which latter star alone has a brilliancy of 350, making its total brightness 550 times that of the sun. No other first magnitude star boasts of a companion with a brightness of more than one tenth of that of the companion of Beta Centauri.

TABLE OF FIRST MAGNITUDE STARS

PREPARED BY FREDERIC CAMPBELL, Sc D

No.	Name.	Mag.	Light Received.	Distance in Light Years.	Brilliancy times Sun.	Approach (−) Recession (+) Miles per Sec
1	Sirius	−1.6	100	8.7	48	−5
2	Canopus*	−0.9	52	466	10,000 +	+12.4
3	Alpha Centauri*	0.1	21	4.3	2	−13.7
4	Vega	0.1	21	34.7	160	−9.3
5	Capella	0.2	19	49.4	300	+18.6
6	Arcturus	0.2	19	43.5	230	−3.1
7	Rigel	0.3	18	466	4,000 +	0
8	Procyon	0.5	15	10.1	10	−2.5
9	Achernar*	0.6	13	64	350	
10	Altair	0.9	10	13.7	12	−20.5
11	Betelgeuse	0.9	10	109	1,400	−17.5
12	Beta Centauri*	0.9	10	88.1	277	....
13	Alpha Crucis*	1.1	8	59.8	207	
14	Aldebaran	1.1	8	44.7	110	+34.2
15	Spica	1.2	8	500 +	2,000 +	+1.2
16	Pollux	1.2	8	50.9	125	+1.0
17	Antares	1.2	8	112	680	−1.9
18	Fomalhaut	1.3	7	23.6	25	.....
19	Deneb	1.3	7	500 +	1,800 +	−30
20	Regulus	1.3	7	90	420	+23

* Southern stars.

The Electrolysis of an Egg

By Albert A. Somerville

SUPPOSE the ends of an egg are punctured, so as to admit small wires, and that by means of these two lead wires the egg is made a part of an electrical circuit, all of which is easily done. Now the electrical resistance of the egg may be measured in ohms, *probably*. Then if the terminals are connected to a power circuit, current may be sent through the egg and thereby generate sufficient heat to cook it, *possibly*. Now that egg is neither fried, boiled, poached nor scrambled. If it is cooked at all, will someone be so kind as to suggest a name for it to put on a bill-of-fare in some Broadway café? Someone has suggested that it might be known as an electrocuted egg. This would probably apply better if there were a chicken inside.

The body of an egg consists primarily of a great mass of albumen. When the contents are decomposed by time or by an electric current there is formed a large volume of gases, principally nitrogen, hydrogen, and oxygen.

The shell consists mostly of carbonate of lime, and may be so nearly colorless or translucent that the contents of a fresh egg show a pinkish blush through it.

The idea of the investigation was to cook the egg by sending current through it, its own resistance causing the requisite heat to be generated upon passage of the current.

It is well known that the amount of heat generated per unit of time in an electrical circuit is proportional to the current flowing multiplied by the electromotive force, or stated another way, is proportional to the product of the current squared and the resistance. Also it is known that great progress is being made along the line of electrical heating for scientific, commercial and domestic purposes. Even though the efficiency is fairly high the expense of electrical heating is considerable, and as yet the only thing to recommend it is its cleanliness and convenience. For scientific and commercial work, where very high temperatures are desired, arc furnaces are used principally. In domestic use, where only moderate temperatures are required, the resistance type of heater is used, the resistance unit formerly being wound with some pure wire, and more recently with some alloy having smaller coefficients of variation with temperature change. That is, if the length of the wire is nearly constant at all temperatures it is easier to [illegible] and hold it in place, and if the resistance is nearly constant the variation in current is easier to control.

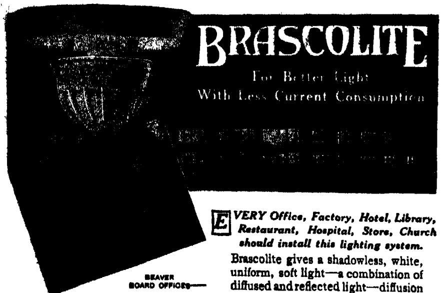
If a heater is to be made, the resistance is adjusted so that if connected to a certain common voltage a certain temperature will be attained in a specified time. All the heat generated or nearly all has gone into the heater, but even from there not more than half of it gets to the desired point where the heat is to be applied in the case of most heating appliances, and it is only in a few cases that the heating unit can be located within the thing to be heated so as to utilize practically all of the heat to advantage.

If the thing to be heated could itself be made the conductor to carry the current and to offer suitable resistance to the same, then all the heat would be generated within the body to be heated and the efficiency would approach 100 per cent as soon as possible.

A 16 candle-power incandescent carbon lamp measures about 220 ohms and draws ½ ampere on a 110-volt line. If placed in a vessel containing water it will bring a pint of water to the boiling point in a very reasonable time. Instead, however, of using the lamp as a heater two terminals may dip into the water when properly prepared and the resistance of the water itself may be used as the heating unit instead of a wire coil. The resistance of the human body is said to be anything from 5,000 to 15,000 ohms, so that of a slice of meat ought to be something within the hundreds, and if placed between two metallic plates or conductors connected to a line or proper voltage, such a slice of meat should be cooked by means of the current by virtue of its own resistance.

The electrical resistance of a loaf of baker's bread taken from end to end is about 2,000 ohms, so the resistance crosswise of a slice of the same is about 100 to 200 ohms, as readily measured by a Wheatstone bridge method. If a slice were placed between the two metallic plates connected to proper voltage it should be nicely toasted, and then since toasted bread is an insulator, it should automatically cut off current when it is thoroughly toasted or done.

In all these cases all the heat is generated in the thing itself which is to be heated, so very little heat is lost. The method was actually tried upon an egg in the manner indicated in the opening paragraph. Three distinct steps were made in the experiment. It was necessary to know



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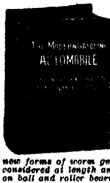

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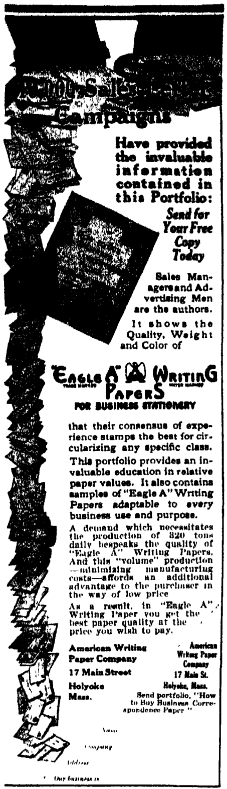
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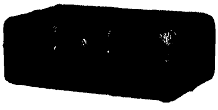
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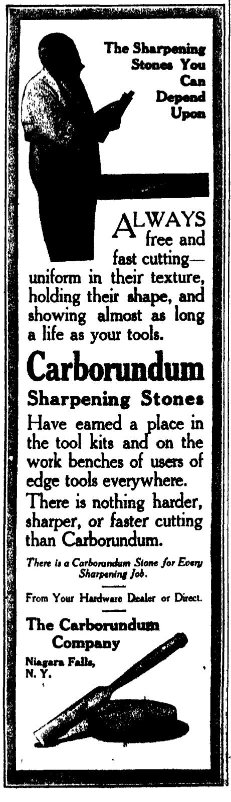
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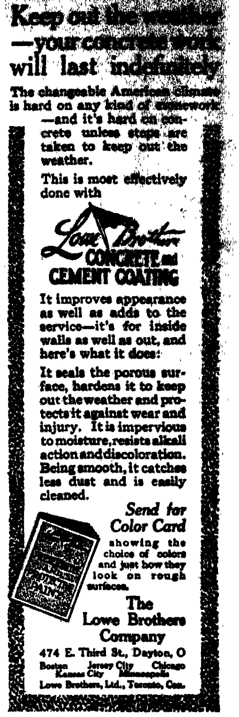
whether or not the contents of an egg would carry a current or whether it was a high insulator, or if not, what its electrical resistance would measure. For this first part, small holes were pricked in the opposite ends of a fresh hen's egg, small copper wires inserted through these holes to a depth of a quarter of an inch or more, and these wires connected to the Wheatstone bridge. The resistance of the egg would then be measured just like any other unknown resistance. When the circuit was first closed and the bridge balanced a resistance of about 1,000 ohms was indicated, but this resistance slowly and steadily increased for several minutes until its former value was more than doubled. If the circuit was broken for a few minutes and then closed again, the original resistance was regained and the same change was executed as before. This could be repeated many times. Only one or two volts of electromotive force was being used, and it was thought that this change in resistance was due to some change taking place at the terminals, which would be overcome by using a higher voltage.

The terminals were accordingly connected onto a 110-volt direct current supply, with an ammeter and voltmeter in circuit so as to measure the resistance by means of the relations $C = \frac{V}{R}$ or by what is known as the "potential drop" method.

When the circuit was first completed the ammeter registered about one tenth of an ampère, thus indicating the proper resistance of approximately 1,000 ohms. Shortly, however, the current began to decrease, indicating an increase in resistance, the potential drop remaining constant, and this increase in resistance went on much faster than when only one or two volts were used in the Wheatstone bridge method.

The current decreased until almost inappreciable. The holes in the ends of the egg where the lead wires were introduced had automatically sealed themselves on standing several hours, so that the egg might ordinarily have been considered intact or air-tight. You have heard of people sweating blood This egg began to sweat albumen. Literally the white of the egg was being forced out through the pores of the shell Practically everything is porous. Water can be forced through the walls of an iron vessel if sufficient pressure is brought to bear upon it. An egg shell is porous. That is the reason for coating eggs with paraffine to prevent air leaking in and so allowing the egg to decay. It is by means of these same pores that the chick receives its oxygen to breathe. Since the white was being forced out through the pores in the shell some pressure must have been brought to bear on the inside. This might be due to heating, but the current was so small by this time that there was no appreciable heating.

Another idea would be that the formation of gas, due to the decomposition of water into hydrogen and oxygen, was the cause of the pressure. One would at first think that these gases would have been forced out through the pores of the shell rather than the white of the egg, but probably both gases and white went out together, the gas carrying small particles of the white with it Finally after about an hour nearly all the white of the egg was forced on the *outside*, the 110 *volts* having been on all this time, the current being measurable only in hundredths of an ampère. Suddenly there was a spark and an explosion—it seems that the hydrogen and oxygen had been separated by the current and the gases formed, after forcing most of the white of the egg out of the shell, had then circulated around until the resistance broke down at some point, allowing a spark to pass, and so set off the gases which were present in the right proportion to produce a good explosive mixture. Anyone who has ever seen a mixture of hydrogen and oxygen exploded in a glass flask may have just a slight idea of what happened when the gases in that egg shell exploded. Only a deep-sea diver's suit could have protected a man from the spattering.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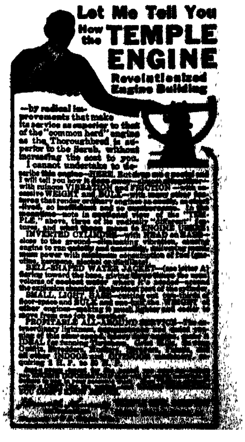
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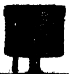

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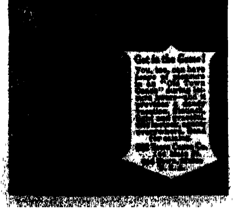


It was then decided to use an alternating instead of direct current in the hopes that this decomposition would not occur. Also, it was possible to obtain higher voltages from the alternating current supply. It was accordingly tried with these results. Voltage was varied from 175 to 235 and 575 volts, successively. The current remained at 0.1 ampère for some time, and finally gradually decreased at the higher voltage to about 0.01 ampère. Evidently the egg became to some extent a rectifier. At one terminal only there occurred continuously a series of very small explosions which could be distinguished from the ordinary sparking, which sparking made the egg beautifully translucent throughout. It was also accompanied by a very distasteful odor not unlike that of decayed eggs or burning horn. Since there was no cooking whatever it was thought best to call the experiment that of "The Electrolysis of an Egg."

Motion Pictures of Vocal Chords

By Jacques Boyer

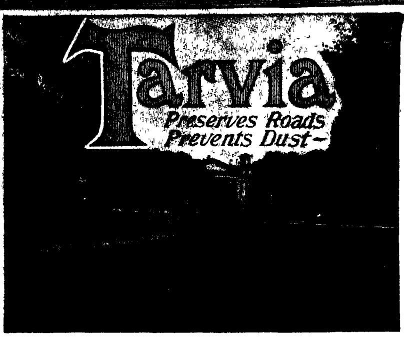
ALL vocal sounds originate in the larynx, where the breath is forced through a slit formed by two membranous cartilages, which are popularly known as the vocal chords. These cartilages approach and recede from each other, thus varying the width of the slit, and they are thrown by the outrushing air into vibrations of greater or less rapidity, which are communicated to the air current which has excited them. The buccal cavity, comprised between the glottis and palate and the lips, acts as a resonator, reinforcing certain harmonic components of the original complex vibration and giving the sound its particular vowel quality, while the consonants are produced by movements of the tongue and lips. In other words, the voice results from a laryngian vibration modified by the cavity of the mouth and other supra-laryngeal resonators.

The exceedingly rapid aerial vibrations which constitute spoken words—from 80 to 1,000 vibrations per second—were photographed by Dr. Marage, years ago, and now Mlle. Chevroton and Mons. F. Vlès, with the collaboration of Mme. Marage, have obtained motion pictures of the movements of the vocal chords. These experiments are so delicate and so irksome to the subject that they had scarcely been attempted before with human subjects. Czermak, Stein, French, Wagner, Brown, Blucke, Cadett and others had endeavored to photograph the glottis in fixed positions, but had obtained only mediocre results. Garel alone had succeeded in producing good stereograms of the vocal chords.

Mlle. Chevroton and Mons. Vlès solved the problem by placing in front of the camera two isosceles right angled prisms connected by their hypotenuses. The rays of an electric arc, made parallel by a lens, are reflected along the axis of the camera to the throat of the subject by one prism, and the rays emitted by the glottis, thus illuminated, pass along the same axis through both prisms to the camera. This invariable relation between the illuminating and the effective rays facilitates the management of the laryngoscope, the position of which relative to the photographic field can easily be rectified by means of a total reflection prism placed behind the film.

From a study of the cinematograph films thus produced it appears that most parts of the larynx contract in passing from respiration to voice production. In general, the maximum width of the vocal chords coincides with their maximum apparent length, and their phases of repose and of widest separation, during inspiration. The sharpest photographs are obtained at these epochs. The measurements of the length of the vocal chords possess less interest, as the part played by each element in the change of length is not known, and the shortening of the chords is marked by the movements of the epiglottis and cricoid and by a general contraction of the uppert part of the larynx.

On the other hand, the minimum width of the vocal chords coincides with their minimum apparent length and their phases of sound emission and closest approxima-



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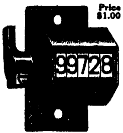

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tion. At these instants the photographs are least sharp, because of the rapid vibrations of the chords. According to the experiments of Prof. Franck of the Collège de France, the limits of physiological variation in width of the vocal chords of a soprano are 3.2 millimeters (0.126 inch) and 1.4 millimeters (0.055 inch).

In the transition from inspiration to phonation or, more generally, during any sudden and profound change of position, the vocal chords appear to be the seat of vibrations of great amplitude and brief duration which produce multiple images of the source of light in the little mirror of the laryngoscope. This phenomenon, which affected only one of the chords and continued only from 0.1 to 0.8 second, was probably caused by a lack of synchronism in the movements of the various muscles involved in the change of position, the still lax chords being violently shaken either directly by the muscles or indirectly by variations of air pressure produced by their movements.

This novel application of cinematography will doubtless throw light on more than one hitherto obscure point in the physiology and pathology of the larynx.

How Scientists Are Studying the Aeroplane

(Concluded from page 285.)

stallation. This transportable testing plant mainly consists of a light carriage traveling on rails, which is driven by the propeller itself, actuated in its turn by a 60 horsepower automobile motor. All measurements are recorded automatically. The propeller shaft arranged about 3.5 meters above the track is so combined with a parallelogram that the whole system is free to move in the direction of the thrust, transmitted by an angle lever to a cylinder, the pressure of which is transferred hydraulically to a recording manometer. Moreover, the upper casing is free to pendulate round the propeller shaft, so that the reaction of the torque also tends to produce a deflection, transmitted to the same recording manometer

A special branch of meteorological work, *aerology*, has been formed of late years, mainly with a view of investigating the higher strata of the atmosphere, which are important for aerial navigation.

The Royal Aeronautical Observatory conducted by Prof. Assmann is situated at Lindenberg on a hill dominating the surroundings, at 65 kilometers to the southeast of Berlin. It comprises in addition to the laboratory-rooms, a small balloon hangar and a rotatable capstan house erected on the top of the hill, whence kite and balloon ascents are made; further an electrical power house which also manufactures the necessary hydrogen, by means of a Schmidt electrolyzer. Apart from kites and captive balloons carrying recording apparatus, there are launched pilot balloons, the course of which is followed by means of special theodolites from trigonometrical stations situated 3 kilometers apart and connected together by telephone. The wind conditions in the free atmosphere are gaged daily at 15 places in Germany by pilot balloons, and are communicated to Lindenberg, in order to be thence transmitted on in the form of collective telegrams. Special gale and thunder storm observations, according to a scheme organized by Assmann, are telegraphed immediately to Lindenberg from about 500 places, situated in North Germany, thus allowing the arrival of a gale or thunder storm, at a given place to be predetermined.

The aerological departments of other German meteorological observatories are arranged in a similar manner. The Teneriffe Observatory, which has been organized by Prof. Hergesell, mainly serves for observations of the higher atmospheric strata above the sea by means of twin balloons.

A propeller testing plant has been recently installed by the Siemens-Schuckert-Werke at Berlin-Nonnendamm on a high speed test electric locomotive traveling on a circular track 270 meters in diameter.

Interesting experiments have also been made by Prof. Donat Banki with a Blériot monoplane fixed by its front wheels on the roof of a rail-motor car, thus allowing its stability to be tested at speeds of 60 kilometers and more.

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NEW BOOKS, ETC.

Work, Wages and Profits. By H. L. Gantt. New York: The Engineering Magazine Company, 1913. 8vo.; 312 pp.

The addition of more than a hundred pages to the first edition of this work has given Mr. Gantt the opportunity of correcting the impression that his methods are summed up in the bonus system. This is but one feature of the plan so successfully initiated by the author, and preceding this feature and forming the very foundations upon which the system rests are microscopic investigation, thorough standardization, personal instruction, and interconnected reward both to the supervisor and the workman. The illustrations used are drawn mainly from the textile industry. The results secured by the system in this industry are little short of phenomenal, as is graphically shown by the series of colored charts that form inserts to the volume. We see, for example, the time-sheet of a weave room. The workman is required to reach a certain standard of efficiency before he is entitled to a bonus; the days in which he fails to earn this bonus are blocked in with red; those on which a bonus is earned are blocked in with black. Steady improvement is noted as our eye crosses the page, until at the end of a few months red has almost entirely given place to black—inefficiency to efficiency, low earnings to high. Such actual records of achievement are attractive to the verge of conviction. Certainly they bespeak for such systems a fair trial

Industrial Chemistry for Engineering Students. By Henry K. Benson, Ph.D. New York: The Macmillan Company, 1913. 8vo.; 431 pp.; illustrated.

The student having some knowledge of elementary physics and general chemistry will find in this text a useful guide dealing with the materials, processes and apparatus commonly used in the engineering professions. The lessons take up such subjects as the atmosphere, industrial water, combustion, distillation, fuels and lubricating oils. Various products of manufacture are also described —pig iron, commercial iron and steel and their alloys, clay, cement and lime products, paving, and paint materials. Cellulose products and explosives also have their chapters. In short, the prospective engineer who follows the text with care and thoroughness will find himself possessed of a working knowledge of the chemistry of materials and processes, and an ability in the pursuit of experimental research that will go far toward solving his problems

Success with Hens. By Robert Joos. Chicago: Forbes & Co., 1914. 12mo, 234 pp. Price, $1 net.

The Back Yard Farmer. By J. Willard Bolte Chicago: Forbes & Co., 1914 12mo.; 238 pp. Price, $1 net.

Regarded as a crop, the product of our "billion-dollar industry" is in value second only to corn, and exceeds that of oats and wheat combined "Success with Hens" exudes common sense, and avoids the impossible estimates and extravagant promises that too often mar books of this kind. It instructs the tyro in the various subtleties of the occupation, details methods of equipment, hatching, brooding and feeding, considers both intensive and extensive systems of farming, and meets with practical advice the drawbacks and exigencies encountered in the business. "The Back Yard Farmer" also devotes nearly half its space to poultry, the remainder discusses plans for making the back yard pay dividends by way of the fruit and vegetable garden Hedges, shrubs, fruit trees, vines and the general beautification of the lawn and the surroundings come in for consideration, and there are hints on the keeping of bees and the care of the horse and the cow This manual also maintains a conservative tone, and its instructions are based on sound principles.

Laboratory Manual of Glass-Blowing. By Francis C. Frary, Ph.D. New York: McGraw-Hill Book Company, Inc., 1914. 16mo.; 60 pp.; illustrated. Price, 75 cents net.

The elements and processes of glass-blowing are presented with the aim of enabling the laboratory man to modify or repair his own apparatus In some situations this may mean the saving of considerable time and money. The author assumes that the reader is entirely ignorant of the art, hence his explanations are lucid and adequate

A Manual of Bacteriology. For Agricultural and General Science Students. By Howard S. Reed, Ph.D. New York: Ginn & Co., 1914. 8vo.; 179 pp.; illustrated. Price, $1.25.

Students will find, in this manual, experiments whose precise results will banish doubtful habits of thought and the consequent vagueness of understanding An added section of the work takes up fermentations caused principally by fungi. There is a large section of appendices, dealing with such subjects as sterilization, and containing tables of determinations, conversion tables, and record forms.

Boy's Book on Logic. A Talk, Not a Treatise. By William Timothy Call. Brooklyn, N. Y.: W. T. Call, 1914. 16mo.; 96 pp. Price, 50 cents.

We are inclined to think Mr. Call's pabulum a trifle too cynically flavored for youthful consumption; there is too much of the strong man's meat along with the milk for babes, but the tiny volume is marked by the author's usual aptitude for getting down to fundamentals and expressing certain forms of truth in a humorous and alluring way. We are initiated into the mysteries of faro; we [illegible] of the thin hind legs; incidentally and [illegible] we absorb a few principles of logic Every boy will be in hearty accord with Mr Call in his desire to simplify grammar—to "strip it to the buff," as he terms it. There is no law confining the perusal of the book to boys, and those of a larger growth may enjoy and profit by it.

The Climate and Weather of Australia. By H. A. Hunt, Griffith Taylor, B.A., B.Sc., and E. T. Quayle, B.A Melbourne. By Authority Albert J. Mullett, Government Printer, 1913. 8vo.; 93 pp; illustrated. Price, 5s.

This, the first published text-book on Australian meteorology, is issued under the authority of the Minister of State for Home Affairs. Under "Climate" it treats of the effect of the size of the continent on climatic variation, of the march of temperature, the barometric variation, the distribution of dominant winds, special factors of climatic influence, and the chief climatic regions Under "Weather" are discussed the characteristics of drought years, local rains, hurricanes and "bursters" Methods of forecasting are sketched, and the monograph is enriched by numerous maps of mean temperatures, heat waves, pressures, humidities, and rainfalls, by graphs of the mean monthly rainfall and of maximum and minimum temperatures for the various stations, and by charts of noteworthy hurricanes.

The South America Tour. By Annie S. Peck, M.A. New York: George H. Doran Company, 1913. 8vo.; 398 pp.; illustrated Price, $2.50 net.

The questions "What is there to see?" and "May the journey be taken in comfort?" are answered with a wealth of detail in the pages of Miss Peck's rather bulky volume She unfolds before us some of the finest scenery in the world—mountains that shame the Alps, cliffs overtopping those of the Yosemite, far-flung gardens of Allah, waterfalls among the highest and the most beautiful in the world The intermingling of strange peoples, the fascinating mosaic of ancient and modern, ruins and antiquities on the one hand and railroads and splendid city buildings on the other, call to us from the happy descriptions of the author's pen and the clear reproductions of her camera. These assure us of comfort on the way, and tempt us, if not to the actual undertaking of the journey, at least to the continuance of the personally-conducted tour by which she leads us through the pages of her attractive volume

The Home Nurse. By E. B. Lowry, M.D. Chicago: Forbes & Co., 1914. 12mo.; 224 pp. Price, $1 net.

The importance of good nursing in illness can scarcely be over-estimated. There are thousands of homes where a trained nurse cannot be employed, and where the duties of nurse devolve upon a member of the family Willing as she may be, her efforts are too often ill directed, and the physician's orders are but indifferently carried out Dr Lowry's book publishes the principles of general nursing—the care of the sick-room and the patient the observation of symptoms, and the administration of medicine, it gives instructions for nursing in special diseases—typhoid, pneumonia, etc., and cites simple remedies and modes of relief for those minor disorders and accidents which occur in every home

The Mechanical Engineer's Reference Book. A Handbook of Tables, Formulas and Methods for Engineers, Students and Draughtsmen. By Henry Harrison Suplee, B Sc, M.E. Philadelphia: J B Lippincott Company, 1913. 16mo.; 964 pp.; illustrated.

In any compilation of tables, methods and formulas, the merit of the resulting volume largely depends upon the selective judgment of the compiler With such a vast field as that of engineering, the task calls for exceptional knowledge, close valuations, and alert faculties, even though the material be limited to the mechanical section of that field This reference book has stood the test of time, and having been recently revised and enlarged, now passes also the test of timeliness Machine design is very fully dealt with, and the men of the draughting room will find in the book both general principles and detailed methods Only the more widely applicable rules and formulas are furnished Thus not the user's shoulders, but the author's, bear the burden of selection.

Village Improvement. By Parris Thaxter Farwell. New York. Sturgis & Walton Company, 1913. 16mo.; 362 pp.; illustrated

"Village Improvement" is a well-planned and informing little book dealing with all phases of town-beautification Addressed particularly to those not having ready access to libraries and hence somewhat out of touch with the progress that is being made, it teaches how, with little expense and small trouble, one may surround his home and his farm with the improvements that mean so much in convenience and in solid satisfaction. The work presents village improvement in its general aspects, and from that proceeds to specific and practical suggestions in regard to roads, greens, fountains, shrubbery, bridges and buildings. A form of constitution adapted to improvement clubs is given, and proved methods of operation are recounted very fully. Pictures of what has thus been accomplished the country over brighten the pages and add to their inspirational value.

The New Philosophy. Science of Physical Phenomena. By Calvin Samuel Page. First Explanations of Electricity, Gravitation, Repulsion, and the New Atomic Element Rex. Chicago: The Science Publishing Company, 1913.

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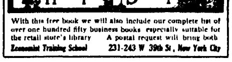

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Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12961) E. H. asks: 1. Would a 10-pound weight of iron sink to the bottom of the deepest part of the ocean, if thrown into it, or would it float at a certain depth? A An iron weight, or chain, would sink to the bottom in the deepest part of the ocean Iron is 7 7 times as heavy as water, and must sink in water The water at the bottom of the ocean is but 1-20 heavier than at the surface, since water is practically incompressible Hence there is no point at which the iron can stop and float Mere pressure does not prevent sinking The air presses upon us tremendously, but we fall readily through it, because the pressure is equal in all directions The same is the case with sinking in the water 2 If it did sink, would it gain velocity as it went deeper? A Calculation based upon theory shows that an iron weight will gain velocity as it falls in water until a depth of about 2 miles is reached after which the velocity will become uniform, and will be 321 feet per second The solution is to be found in Thomas Webster's "Theory of the Equilibrium and Motion of Fluids,' London, 1836 The quantities given above are for solid spheres, and not for other shapes 3 Is there any part of the Atlantic Ocean that is too deep to sound? A There is no place known, in any ocean, which has not been sounded The greatest depth is over 6 miles It is in the Pacific Ocean

(12962) B S asks· Please be so kind as to tell me in the Notes and Queries what are the electrolyte and electrodes of the Nodon valve and what is the efficiency of that apparatus in rectifying the 110-volt alternating current? A For a Nodon valve aluminium and lead plates are *ordinarily employed*, and ammonium phosphate for the solution Full instructions may be found for the construction in our SUPPLEMENT 1679 Another good article on this subject is to be found in SUPPLEMENT 1644, and another form of electrolytic rectifier is described in the SCIENTIFIC AMERICAN, vol 109, No 13 We send the three copies for 30 cents

(12963) B. F. C. asks: 1 In discussing latent heat as connected with making ice cream, is it proper to say that salt has an affinity for heat? Does salt have an affinity for ice or water, and what is the chemical reason why ice melts when in contact with salt? A There is no chemical action involved in the melting of salt and ice It is a simple physical fact that salt and ice melt when brought into contact with each other So, too, do many other substances Melting is always accompanied by the loss of heat—the heat necessary to melt the substances The freezing point of the solution is lower than that of either the salt or the ice It is 7.6 deg Fahr below zero and 39 6 deg Fahr below the freezing point of water The freezing point of a solution is always lower than that of the solvent. So salt dissolved in water lowers the freezing point of the water 2 What amount of rainfall would be equivalent to one foot of average snow? A The U S Weather Bureau allows one inch of water for each ten inches of snow as a fair average of dry and wet snow

(12964) J. T. E. asks. I would be glad to be informed through your paper as to the following Is there a known solid which has an electrical resistance in proportion to the pressure upon it, either by compression of the solid itself or of the contacts? A Carbon is the material for a rheostat which meets the condition which you impose, that its resistance shall vary with the pressure Plates of gas carbon are placed in a retaining box and a screw brings them into closer contact, thus increasing the current which flows through the box The plates stand upon edge, so that their weight does not add to the pressure at the bottom, as would be the case if they were laid flat piled up upon each other They are rated to carry about 125 amperes per square inch You can obtain such rheostats from any dealer in electrical apparatus

(12965) G R L. asks In the discharge of lightning, does all of the current pass from cloud to earth or is the current an oscillating one? A The discharge of the electric stress between a cloud and the earth takes place in either direction or both directions at once. An old professor of physics used to say that he had trained himself to see the flash go either way as he chose The duration of a flash is so very brief that the eye cannot take cognizance of its direction, and it may well be that one can see it go up or down as his mental association suggests The flash may also oscillate and pass many times up and down before it dies out In such a case it may be photographed as banded lightning by rotating the camera during the discharge You will find a valuable article on this subject, with illustrations, in our SUPPLEMENT 1635, price ten cents.

(12966) M. T asks: Two vessels identical in every respect concerning weight, size, volume and shape are placed on a pair of scales. One of them contains hydrogen at the ordinary atmospheric pressure, while the other vessel is a complete vacuum The weighing operation is done in air Now which of these two vessels would weigh more—the one containing hydrogen or the other? A A vessel which contains hydrogen will weigh more than one in which is a vacuum and which therefore contains nothing, whether weighed in the air or in a vacuum Hydrogen at atmospheric pressure and at the freezing point weighs 0 00562 pound per cubic foot, and that quantity is the amount which the vessel containing the hydrogen would weigh more than *the other for* each cubic foot of its contents.

(12967) E McM. asks: Is there any method of sterilizing cloth that can be used at home? One that does not ruin the material. A The simplest way to disinfect cloth is by the use of heat Cloth may be heated to 250 deg Fahr without injury, so that clothes, bedding and cloth generally can be disinfected in this way with entire safety Another method is by exposing the cloth to the action of the vapor of formaldehyde Formalin heated in a basin will give off the vapor abundantly and any cloth which is permeated by this vapor will be disinfected It does not affect the color of the cloth

(12968) R M. S asks: Cannot the gyroscope be applied either directly or indirectly to the guiding and control of an equatorial telescope, in place of clockwork? A We are not prepared to pass upon the possibility of controlling an equatorial telescope by a gyroscope It is a question of the perfection of a mechanical appliance A *gyroscope might be made to run as uniformly as* the best clock movement, in which case it could be applied to a telescope

(12969) E. S. M writes: In your answer to F D D, Query 12943, in the current issue of your very valuable paper, you do not set the gentleman right in one particular, and, as this matter proved a source of annoyance to me, I venture to suggest that you refer him to page 200 of the Nautical Almanack, where nearly the identical problem is stated thus

January 21st, Sid. Time at G M.

Noon	.	20	00	01	35
Red (None in this case)	. . .				
Add local Ast mean time . .		18	17	20	
Sid time (less 24 hours)	.	14	17	21	35

His mistake is in overlooking the fact that the Siderial Time at his place is the sum of the Siderial Time at that instant (corrected) plus his local Ast Mean Time for that instant His clock face should show the Right Ascension of his meridian, *not that of Greenwich* The figures above are taken from his data to make it a little plainer

(12970) R. B asks. Can you explain why these odd weights and dimensions were adopted for the unit of electrical resistance—the ohm? 14.4521 grammes mercury at 0 degrees, when in the form of a uniform cylinder 106 3 centimeters, having a section therefore, of practically 1 square millimeter Why not 15 grammes Hg at 22 deg Cent, 100 centimeters long, 1 square millimeter in section? It is noticed in a good many standard units, that odd figures are given For instance, the ampere, defined as electricity depositing 0 001118 gramme of silver per second Why not 0 001 gramme? A Perhaps the simplest presentation of the subject of the derivation of the electrical units to which we can refer you is in Silvanus P Thompson's "Elementary Lessons in Electricity and Magnetism," price $1 55 postpaid, found under the heading "Units" in the index The electrical units were determined and adopted by an International Congress of *Electricians*, which met in Chicago in 1893, composed of delegates from the nations of the world, officially commissioned by their governments to act in this capacity The several units are derived from the absolute or centimeter-gramme-second unit of force, the dyne Thus, a current has unit strength when its circuit bent into an arc of one centimeter radius exerts a force of one dyne upon a unit magnet pole placed at the center of the arc. There exists a unit of difference of potential between two points when one erg of work is done in bringing one unit of positive electricity from one point to the other against an equal and similar electric force And there exists one unit *of resistance* in a conductor when one unit of difference of potential will cause one unit of current strength to flow through the wire. So, too, for all the other units of the system Some of these absolute units are too large, and others are too small for practical use For this reason other units, called practical units, are employed which have definite relations to the absolute units The ampere is one of these and is one tenth of the absolute unit *of current strength*. It will deposit the weight of silver which you name This weight has been determined with minutest care So, too, the ohm is 10^9 absolute units of resistance, and it was determined with the highest accuracy The length of the mercury column was not guessed at, but is the exact quantity required, and it will have just the weight you give. Considering the enormous sums of money which are invested in electrical enterprises, the importance of the accurate measurement of electrical quantities is evident Considering that America is exporting hundreds of millions of dollars worth of electrical apparatus every year, the importance of an international agreement, upon what shall constitute the value of the units in which its work shall be rated, is also evident Our machinery should come exactly to the value set by international agreement, not pretty near to it. An ampere of exactly 0.001118 gramme of silver per second, and not 0.001 gramme, is what we ought to give.

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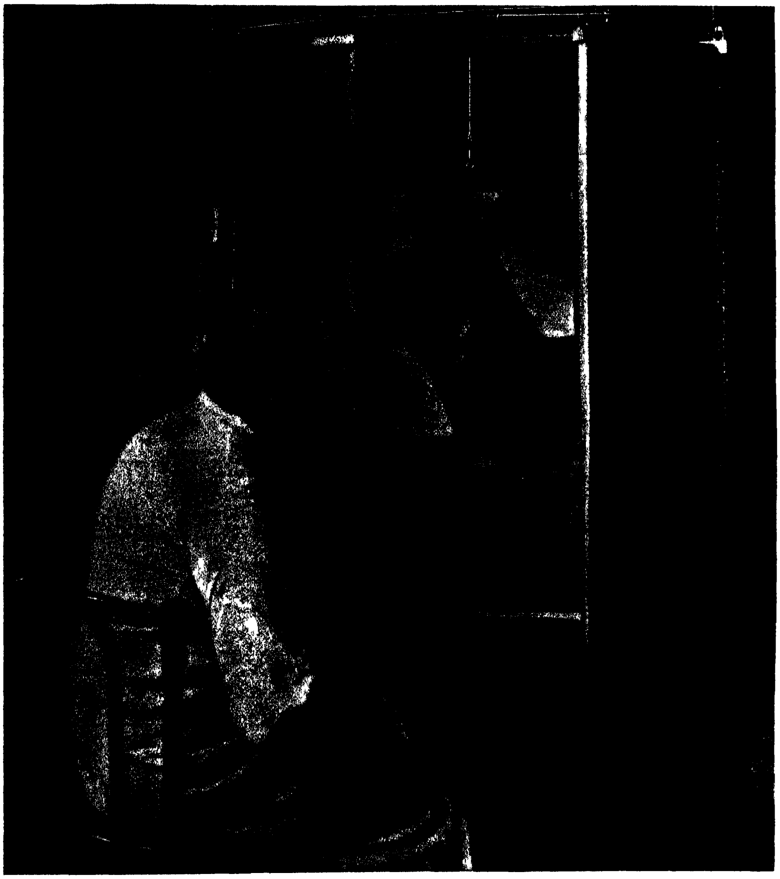

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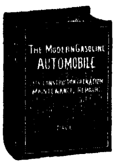

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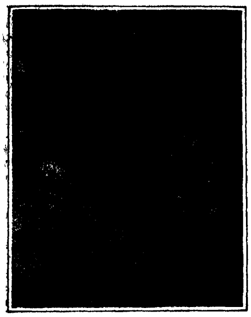

"Cathedral cut" at Chuquicamata.

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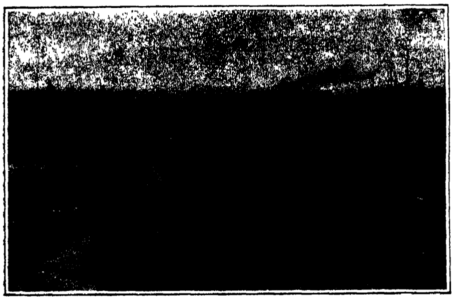
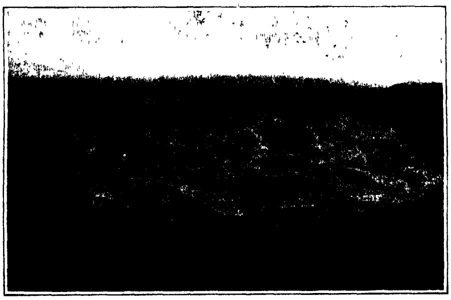
A native ore concentrator.



The port of Tocopilla, where the 40,000-kilowatt plant is being built.



The deposit honeycombed with burrows of individual miners.

A Mountain of Copper

EIGHTY-SIX miles inland from the Chilean port of Tocopilla, a mountain rises to an elevation of 9,500 feet. This is not a remarkable height for a country that lies under the shadow of the Andes and yet the mountain is a conspicuous landmark for miles around because of its bright copper green color; for here is the great copper deposit of Chuquicamata, one of the largest copper deposits in the world. It covers an area 8,000 feet long by 500 to 1,200 feet in width, and the borings so far made indicate that it must contain at least two hundred million cubic yards of copper ore. What such a quantity means we can gather by comparing it with the excavation for the Panama Canal which will total 230,000,000 cubic yards. Most of the deposit consists of two per cent ore, but the value of the ore increases with the depth. Borings which in place have been carried down from 1,000 feet to 1,285 feet show that the underlying ore contains 3.17 per cent of copper.

Up to 1911 the deposit was owned by individuals and separate owners. Because a large part of it is exposed, and there is no surface soil to be stripped off, hundreds of open cuts have been made by miners who sought only high-grade ore. In fact, the whole surface of the mountain is honeycombed with such burrows. Some of them are 300 feet deep, but the total amount of copper excavated is comparatively insignificant, and nothing was done with the low-grade ore. Now the whole mountain has been taken in hand by an American company, which is prepared to excavate the entire deposit and recover the copper it contains by means of the electrolytic method. Work is well under way on a plant which will handle ten thousand tons or more per day.

Electricity will be furnished from a 40,000-kilowatt steam power house at Tocopilla (the man who is not familiar with South American geography will find this port on the map about twenty-two degrees south of the Equator) The power plant will have four turbo-generators of 10,000 kilowatts each. The fuel used in the plant may be either coal or oil, but it is planned to use oil, shipped from the California oil fields The transmission line running from the power plant to the electrolytic plant will be eighty-six miles in length and will be of sufficient capacity to deliver 21,000 kilowatts at the mine This will provide for treating ten thousand tons per day. The current will be transmitted at a voltage of 110,000, and the line will be strung on steel towers, spaced eight to the mile When the capacity of the treatment plant has been increased to double that amount a second transmission line will be erected Although there is some water-power available in the vicinity of the mine, it was decided to build the steam power plant on the coast in order to save time. Later on hydro-electric power will also be used

The ore will be mined with steam shovels from the Panama Canal The method of extracting the copper will be to crush the ore and place it in large concrete tanks. Here it will be treated with a copper sulphate solution, consisting of eight per cent sulphuric acid and one and one half per cent copper After soaking here for forty-eight hours the solution will be passed through the electrolytic tanks where the copper will be deposited. The sulphuric acid left in the tank after the copper has been extracted will be used for the treatment of the crushed ore. After the first treatment with sulphuric acid, no more acid will have to be introduced into the operation as enough will be obtained from the electrolytic tank, which will extract the sulphate in the ore. Experiments with this method of recovery show that ninety per cent of the copper in the ore can be extracted. Hence, it is expected that the ten thousand ton plant now being built will produce 120,000,000 pounds of copper per year. The mill is about three miles from the mine; and a plant railroad is being built which will be about twelve miles long The Chuquicamata mine is reached by a branch line from the Antofagasta and Bolivia Railroad, and is a hundred and fifty miles by rail from Antofagasta

Over fifteen hundred men are at work on the plant.

To accommodate the workmen at Chuquicamata the company is building a city which will contain among other buildings a soldiers' barracks, two public schools, a court house and telegraph and postal building, a theater, a hospital, a public quarantine, a Protestant church and a Catholic church, a music hall for workmen, and a public library The city will consist of two sections, one for foreigners and the other for natives It will probably be the finest industrial town in South America. Work on the plant, the power plant, and the workmen's villages are proceeding rapidly, and it is expected that copper will be produced within a year's time.

Air Pressures in Playing Wind Instruments

IN an interesting article in the *Philosophical Magazine*, Mr. Foord refers to Dr Stone's table of wind pressures required to play various notes of the scale on various wind instruments. The table indicates that as the notes rise higher in the scale the air pressure necessary to produce them increases with most wind instruments, although not with all In the clarinet, for example, the pressure decreases from the low notes to the high ones, varying from 15 inches of water to 8 inches. Mr. Foord repeated these experiments on the clarinet and saxophone, playing the whole range of notes first loudly and then softly For the clarinet it is found that the pressures fall as the notes rise, agreeing with Dr Stone's table, although the inverse law holds good for the oboe, bassoon, horn, cornet, trumpet, euphonium, and bombardon.

With the saxophone it is found that the pressures corresponding to notes at the beginning and end of the register are equal, the pressure rising to a maximum at the note D about half-way through the scale

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The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Tolls Question in the House of Representatives

ALTHOUGH on grounds of decency and dignity there was much to deplore in the debate which preceded the passage of the Tolls Repeal Bill in the House, it is perhaps as well that its opponents should have given loose rein to the prejudices and animosities which characterized their speeches These gentlemen have spoken and the country has listened with close attention, with much enlightenment, and incidentally with no little amazement

The country has a right to expect of its representatives that whenever a subject of grave international importance, such as this question of tolls, comes up for debate, it shall be considered strictly upon its merits, and that the discussion shall be free from the least taint of mere party politics and all the insincerity, byplay, and subterfuge which the "political game" implies Above all, a debate of this kind should never be vulgarized by the interjection of personalities

Say what he will, the most bitter opponent of repeal must admit that this country is on trial before the whole world in the matter of its good faith and the sanctity of its treaty obligations There is no getting away from this fact; for the President himself, in a joint session of the two Houses, has so stated the situation, telling Congress in simple words of unmistakable meaning, that the honor of the country was at stake

Surely, anyone with the most elementary sense of ethics, or even of the common proprieties, must have felt that this was an occasion for cautious and dignified debate; and to the credit of many of the opponents of the bill, it can be said that their speeches were delivered in this spirit.

But, although many of the representatives spoke and voted against repeal under a mistaken but sincere misapprehension of the treaty, some of the opposition were manifestly swayed by other motives than a desire to get at the truth. Among these were subsidy seekers pure and simple; those who do not hesitate to stir up racial animosity; and not a few who did not disdain to descend to personal abuse of the President himself

As regards the last-named, it is sufficient to say that envy has ever been the parent of malice President Wilson is too firmly established in the confidence and respect of the country to be shaken by the angry ·battering of a few disappointed politicians

There is no doubt that the principal opposition to the bill comes from the coastwise shipping interests and from the politicians. Such opposition as has been developed among the public at large is the result of an active campaign, in which the arguments have been of the most specious character, and have consisted largely in an appeal to racial prejudice We had hoped that this sort of tactics belonged to an earlier and cruder day No one seriously believes that the President has taken his firm stand in favor of fulfilling treaty obligations on any other ground than that of national honor. To suggest that he is acting under pressure from any foreign power, and that he has made a "deal," in which our own treaty rights have been used to buy off foreign interference in Mexico or elsewhere, is to do violence to the very qualities which have won for our President so strong a hold upon the confidence and high regard of the country.

The Tolls Bill has gone to the Senate strengthened by the prestige of its passage through the House. The questions involved are: First, can we as a nation which boasts of its square dealing afford to repudiate a clearly-stated treaty obligation? Second, is there any good reason why a large portion of the revenues of the Canal, built, as it has been, by all the people of the country, should be diverted to that exceedingly small minority of the people who own and run our coastwise shipping? We believe that the patriotism and clear thinking which carried the bill through the House will prevail in the Senate also.

The North River Bridge Problem

PROMINENT among the great engineering questions which perennially thrust their way into public notice through the medium of the public press, is that of the construction of a bridge across the North River. So many have been the ways and means which have been proposed for putting through this work, that the public will welcome in this issue the clear and comprehensive letter from Gustav Lindenthal, who a quarter of a century ago made the first definite proposal and working plans for a bridge across the North River. As Bridge Commissioner under the Mayor Low administration, the writer of this letter had every opportunity to become acquainted with the ins and outs of the construction and operation of great public utilities, and notably of the great bridges which have been built across the East River.

Every one admits that the time is ripe for the provision of larger and more rapid facilities for intercommunication between New York and Jersey City; and the two questions upon which there may be division of opinion are first, as to whether this communication should be established by a single monumental bridge or by multitudinous tunnels; and second, as to whether the results can be best achieved by public money, that is by the cities and States concerned, or by private capital.

Judged on the score of the capacity afforded for a certain cost, there can be no question that a bridge is to be preferred to tunnels. A bridge such as that illustrated in this issue, costing $76,000,000, would have the same capacity as nine pairs of tunnels, costing $180,000,000. Next to the railroad traffic, the automobile traffic will be the largest; and it is certain that the multitudinous automobiles and motor trucks would travel with more safety and convenience by way of a bridge than through tunnels that must be three miles in length if the grades are to be kept down to a reasonable limit There would be serious fire risk in sending a heavy automobile traffic through a three-mile tunnel, and the problem of getting rid of the noisome gases in tunnels of such a length is a very serious one indeed Indeed, the difficulty of ventilating tunnels of that length that were carrying a heavy automobile and motor truck traffic would seem to be almost insuperable.

To insure its success, any plan for connecting Manhattan with New Jersey should include the co-operation of the railroads, at least so far as the handling and distribution of freight is concerned. The present method of distribution by car float and trucking, not only encumbers the river and the Manhattan piers and marginal streets, but it is antiquated and altogether behind the best modern practice. The city has under advisement plans for a great marginal elevated freight railroad and storage warehouses, which would be rendered doubly efficient if the freight trains were brought in to Manhattan over a bridge to a connection with the marginal elevated tracks.

As to the question whether the bridge should be built with public or private funds, we think there can be no doubt that the latter plan, as outlined in Mr Lindenthal's letter, would be the more satisfactory He tells us that every one of the four existing East River bridges cost from 80 to 120 per cent more than the original estimate at the time the bridges were authorized, and this is only in keeping with the sad experience which New York city and State have had with regard to other important engineering works that have been built with public funds. The Catskill Water Supply, originally estimated to cost $160,000,000, will probably total nearer $200,000,000 by the time it is completed; and the Erie Canal, estimated to cost $100,000,000, promises to cost nearly $150,000,000

If the present grossly unfair treatment of the railroads shall come to an end, that is to say, if they are once more permitted to operate according to true economic laws and, therefore, should feel justified in facing large expenditures in improvement of their systems, they will probably find the proposed railway connection with Manhattan an attractive proposition; and if the two States, New York and New Jersey, should co-operate, we understand that there would be no difficulty whatever in securing from private sources the $76,000,000 of capital needed to build the bridge.

Dr. Zimmerman's Aerodynamic Studies

A NOVEL and most important line of work in advancing aeroplane design has been inaugurated by the section for scientific aviation of the *Berliner Verein für Luftschiffahrt*. The task was to determine and correctly measure vital constants of a Grade monoplane, such as weight, center of gravity, moments of inertia, and most important, the several axes of inertia oscillations. Dr. Zimmerman, who worked out the theory of these investigations, was in charge of the work, which with the rather primitive accommodations at his command took no less than twelve days. It was found that to take these important measurements of any finished machine speedily and economically, an entirely new accessory to the flying machine is needed; a large dome-shaped building, with facilities for suspending the aeroplane in any desired fashion, so that it is free to oscillate only about the axis to be investigated, with windlasses, and also swinging galleries, by which any portion of the machine can be approached without disturbing the rest.

These constants are at present only partly known. A correct understanding of the several axes of inertia oscillations (the various axes, fixed by the arrangement of weight, about which a machine begins to rock if its equilibrium is disturbed in different ways), will simplify the all important stability problem, which has so far been dealt with only by cut and try methods, and which in the aeroplane is a matter more of dynamics than of statics. It will give us safer and more useful machines.

Such an advance is more beneficial than a new record made by a flying virtuoso, who cannot impart his personal, almost subconscious art to others.

The Composition of Air and Rain-water in the Antarctic

ONE of the most interesting undertakings of Dr. Charcot's expedition to the Antarctic in 1909 and 1910 was the collection by Ensign R. E. Godfroy of the French navy, in accordance with the instructions of A. Müntz, of a great number of samples of air and meteoric water (rain and melted snow), which have since been analyzed in Paris. An elaborate report on the analyses has been published by Messrs. Müntz and Lainé in the *Annales de l'Institut National Agronomique*. In order to determine the amount of nitric acid in the atmospheric precipitations of the Antarctic, samples of meteoric water, as collected, were dosed with a small quantity of potash, concentrated by evaporation over a flame, mixed with alcohol, and hermetically sealed. This substance is supposed to be formed by the electrical discharges of thunderstorms; a belief supported by the fact of its relative abundance in tropical regions, and its almost complete absence at great altitudes, where thunderstorms rarely occur. The samples brought back by the Charcot expedition show that it is approximately as abundant in the Antarctic as in Europe, despite the rarity of thunderstorms in high southern latitudes. It may, however, be produced elsewhere and carried thither by the winds. Other samples, collected by a different method for testing the percentage of ammonia, show that the latter substance occurs in about the same quantities in the Antarctic as in middle latitudes Samples of air were collected for the purpose of testing the amount of carbon dioxide. In the atmosphere of the world as a whole this gas has heretofore been stated to form a little less than 3 parts in 10,000 by volume. Determinations by Müntz and Aubin at a number of places in the northern hemisphere give a mean of 2.82, while at Cape Horn they found only 2.56. The mean of all the samples collected by the Charcot expedition shows the strikingly low value of 2.05.

The Monthly Weather Review

PERSONS interested in meteorology will be glad to see in the January, 1914, number of the *Monthly Weather Review* a return to something like the scope and character which made this journal one of the most useful periodical publications of the Government prior to July, 1909. The status of meteorology in the United States is peculiar in the fact that all but a very small percentage of its devotees are connected with the official Weather Bureau, either as paid employees or as volunteer observers, and are therefore entitled to be supplied with professional literature at Government expense. For this reason it seems impossible to maintain an independent meteorological journal in this country. The admirable *American Meteorological Journal*, published from 1884 to 1896, was not only a labor of love, but a source of heavy expense to its editors. After it ceased publication the official *Monthly Weather Review* gradually broadened in scope and became known throughout the world as the mouthpiece of American meteorology. In 1907 the Weather Bureau established a more strictly technical and decidedly less readable publication known as the *Bulletin of the Mount Weather Observatory*, and in 1909 the *Monthly Weather Review* became mainly a bulky collection of climatic statistics. Its literary features, though not entirely eliminated, were mostly devoted to questions of local climatology. In short, from July, 1909, to the beginning of the present year, the United States possessed no journal of general meteorology, such as has now, very fortunately, been re-established.

Engineering

The Electrification of Chicago Railway Terminals.—An elaborate report on the question of smoke abatement and the electrification of the railway terminals will be presented in a few months' time by a committee of the Chicago Association of Commerce. The work of the committee was commenced in 1911, and in the interim it has made a most extensive study of 4,500 miles of railway track, including nearly 100 railway yards.

Excellent Torpedo Record.—The United States cruiser "California" recently established a new record for torpedo firing during battle practice off the coast of California. The firing took place at a range of 3,000 yards when the cruiser was steaming at 10 knots. The first five shots were bull's eyes, the sixth was a miss, and the seventh torpedo stuck in the tube, and according to the rules was counted as a shot.

Another Large Motor Ship.—There was launched by Messrs. Harland & Wolff on March 12th a large motor ship, the "Falstria," for the East Asiatic Company, who are the owners of the "Selandia," and sister ship. The "Falstria" is 381 feet long, 50 feet broad and has a gross tonnage of 4,500. The main engines will consist of a pair of Burmeister & Wain four-stroke, six-cylinder Diesel engines, with two auxiliary Diesel engines for the air compressors and dynamos.

An Oil-Burner Record.—The freighter "Santa Cruz" arrived last month at San Francisco with a new record for the passage by way of the Straits of Magellan. From the time the vessel left Sandy Hook till she slowed down off Los Angeles harbor, the engines were run full speed without a stop, and the distance of about 13,000 miles was made in 47 days and 4 hours. The "Santa Cruz" is an oil burner, and therefore did not need to put in at any port for fuel.

The Soo and the Suez Canals Compared.—William C. Redfield, Secretary of Commerce, in a recent address drew attention to the fact that the number of ships passing through the river and canal connecting Lake Huron and Lake Superior amounted last year to nearly three times the number that passed through the Suez Canal. To be exact, 14,916 vessels of 30,974,123 tons passed through the Great Lakes Canal, while 5,300 vessels of 20,275,133 tons passed through the Suez Canal.

The Situation at Cucuracha Slide.—The last number of the *Canal Record* states that approximately 1,000,000 cubic yards of material has been dredged from the toe of Cucuracha slide. The dredges began operation there on October 26th, 1913. On March 4th the channel at the base of the slide had a minimum width of 190 feet and a minimum draft of 20 feet at the level of Gatun Lake. The removal of this material has caused a marked lowering of the masses of material in the upper reaches of the slide

A Concrete Hardening Material.—Mention is made by the *Engineer* of a concrete hardening material containing 95 per cent iron dust or iron flour, which is mixed with cement for finishing the surface of concrete floors. From 15 to 25 pounds of the material is mixed with 100 pounds of the cement while dry, and one part of this mixture to two parts of sand is used for the top coat, which varies from one half inch to one inch in thickness. It is said to make a hard and durable floor. It is serviceable also in making new concrete adhere to old concrete in repair work.

Canal Machinery Should Be Sold.—The suggestion has frequently been made that the canal excavating machinery might be used to good effect in levee work on the lower Mississippi, or that some of the machinery might be used to build the Alaska railroad, or to do general river and harbor work in the United States. Col. Goethals recently told the Senate Commerce Committee that it would be more economical to purchase new machinery outright for the Mississippi improvements than to remove and repair the canal machinery. The only part that might be utilized would be some of the dredges, and these, he thought, would be of doubtful utility. He recommended that cars, dredges, engines and all other machinery be sold to South American interests which wish to use them in railroad building.

United States Collier "Jupiter" Makes Over 15 Knots.—The Navy Department is much gratified with the performance of the large collier "Jupiter," in which is being tried out a system of electrical speed reduction. The motive power consists of a turbine-drive, direct-connected to a generator, current from which drives the propeller shaft motors. The contract calls for the maintenance of a speed of 14 knots for 48 hours continuous steaming. On the recent official trial the collier maintained 15.1 knots for 48 hours, an excellent performance, which compares favorably with that of the sister ships "Neptune" and "Cyclops." The former, fitted with Westinghouse reduction gear, has maintained 14.96 knots for 48 hours, and the "Cyclops," fitted with reciprocating engines, has maintained 14.61 knots for the same length of time.

Science

The Fourth International Botanical Congress will be held in London, May 22nd–29th, 1915.

Paint From Beans.—From Manchuria comes the invention of a new paint that is both waterproof and fireproof in addition to being cheap and durable. "Solite" is the name of this new product, and three months after its introduction it found a ready market in Shanghai, Harbin and Tientsin. It is reported that the Japanese navy is testing it with a view to adoption. "Solite" is made from bean oil which is produced in tremendous quantities in Manchuria.

An 1,800 Years Old Egg.—An egg which cannot be said to be fresh is one which dates from 1,800 years back. It was found during recent excavations made at Nikopolis, in the tomb of an 11 months old child, Sextius Rufus. Already more than 80 tombs have been explored by the archæological service in this ancient city, which was built to commemorate the battle of Actium. Among the finds are a quantity of gold jewels, also pottery and lamps ornamented with elegant figures in relief.

The Kritzinger Comet.—A cablegram received at the Harvard Observatory from Kiel announces the discovery of a comet by Dr. Kritzinger of Bothkamp, in the following position:

March 29.6171 G.M.T.
R.A. 16h. 11m. 39.2s.
Dec. —9° 30′ 45″

The comet had a daily motion of +3m. 08s. in R.A., and +32′ in Dec., and was visible in a small telescope.

Further Exploration of the Abor Country.—The northeast frontier of India has become the theater of active and much-needed exploration by British officials, beginning with the operations of the punitive expedition sent against the Abors after the murder of Messrs. Williamson and Gregorson in 1911. During the past winter, a small party was engaged in exploring and surveying the country of the Akas, the most westerly of the Abor Mishmi group of tribes. This region had not been entered by a British party since 1884.

Shorthand Taught by Moving-picture Slides.—The value of illustrated moving-picture slides for teaching shorthand is being successfully demonstrated by a school of Newark. The principal, A. J. Harding, who originated and developed the scheme, has been working on it for the past year and recently began its use in the shorthand department. The moving-picture idea is not only pleasing and agreeable, but is an incentive to the student to accomplish more, for the reason that he is appealed to from a more interesting point of view.

Tomato Seeds for Fodder.—The Chamber of French Commerce at Milan announces successful attempts to produce a valuable cattle-fodder from the tomato seeds which are a by-product of the canneries. The seeds are desiccated in drying-furnaces and then sifted to separate them from the woody fiber of the debris. They are then crushed by heated mill-stones and the oil which they contain in considerable quantities is separated by a hydraulic press. The residue is pressed into loaves each about two kilogrammes in weight. According to tests at the Agricultural Station at Portici, they contain an abundance of proteids and carbohydrates.

Explorations in Northeastern Siberia, on an extensive scale, have been undertaken by Iden Zeller, especially for the purpose of making ethnological collections for the museums of Hamburg and Leipsic. Starting from Yakutsk with a column of natives, the explorer expects to sledge first to the Kolyma River, where he will spend the latter part of this year. After an excursion all the way to Cape Deshnev, he will travel west to the Yana River, and sledge over the ice to the New Siberian Islands, where he has been commissioned by the Russian government to erect a bronze tablet in memory of the late Baron Toll. Later he will explore along the lower Lena and then westward by way of the Taimyr peninsula to the Yenisei and the Ob. He hopes to complete this remarkable journey late in the summer of 1916.

The Abnormal Propagation of Sound Waves in the Atmosphere is discussed in a recent paper published in Tokyo by S. Fujiwhara (who in other memoirs has spelled his name "Fujihara" and "Fujiwara"). The existence of regions of audibility lying farther from a source of sound than regions in which the sound was inaudible ("zones of silence") has been reported in connection with certain great explosions by G. von dem Borne and A. de Quervain, and made especially prominent by Alfred Wegener, who sees in this phenomenon the result of total reflection of sound from an upper atmospheric stratum of great tenuity. Mr. Fujiwhara has collected numerous reports of the audibility of great explosive volcanic eruptions in Japan. He finds that the existence of a silent region is a usual phenomenon, and that the region of audibility always lies in a special direction from the source of the sound; viz., the same direction as the axis of the region in which sand and ashes fall from the volcano. The principal factor in the anomalous propagation of the sound is the wind, and the phenomenon is found to be closely related to the prevailing type of weather.

Aeronautics

The New Noiseless Zeppelins.—The new army Zeppelin V cruised over Berlin recently with hardly any noise whatever In the past Zeppelins have been conspicuous by reason of their noise. Their approach was heralded long before they appeared, by buzzing motors. The latest Zeppelin, the Z8, flew over Santis Mountain in the Canton of Appenzell on April 1st, and in so doing created a new height record for dirigibles of 10,000 feet.

Entries for the Gordon-Bennett Aviation Cup.—According to *Flight* the following entries have been made to the Royal Aero Club: Messrs. A V Roe & Co, Ltd., Manchester; Sopwith Aviation Company, Ltd., Kingston-on-Thames, British and Colonial Aeroplane Company, Ltd., Bristol; Cedric Lee Company, Shoreham (two machines); Messrs. Vickers, Ltd, Erith and London. The race will be held in France in September or October next, and the Royal Aero Club will select from the foregoing entries three competitors to represent the British Empire.

An Aerodynamic Laboratory for Massachusetts Institute of Technology.—The first structure that the Massachusetts Institute of Technology has caused to be erected for its own uses on its site in Cambridge is the new aerodynamic laboratory. The building is finished and the apparatus is in process of installation. This, together with the fact that Technology has already instituted courses in the study of this science, makes it the first college in the land to be fitted to prepare students for what must in the future be an exceedingly important line of development. The portion of the equipment that is first to be installed, in fact, is nearly ready for use, is the four-foot wind tunnel with its accompanying blower. This is of the pattern now in use at the National Physical Station at Teddington, England.

A Giant Hydro-aeroplane.—The Jeanson-Collieux hydro-aeroplane is one of the largest machines ever built, rivaling indeed even the machine of Sikorsky. It is stated in the French press that the machine flew several miles recently above the Seine River at Priel. The machine is carried by a single boat having a single hydroplane step. The boat is 28.5 feet long by 8.5 feet beam. The aeroplane portion consists of two sets of biplane surfaces arranged in tandem The span is 27 meters (88½ feet) and the total lifting surface 145 square meters (1,560¾ square feet). Within the boat body are two 200 horse-power motors connected by sprocket and chain with a single air propeller 5 meters in diameter. The total weight of the machine with its pilot, assistant pilot, two mechanicians and fuel and oil for a 15-hour flight (1,600 kilometers—994 miles) is 4,700 kilogrammes (10,360 pounds).

The Race to Bermuda.—An aeroplane race from New York to Bermuda, over a flying course of 700 miles, is being organized for the coming summer The machines are to leave here in the last week of June or the first week in July. Prize money to the amount of $25,000 will be awarded upon their arrival in Hamilton Harbor, Bermuda. If the race actually takes place it will be extremely instructive because it will shed much light on the possibility of crossing the Atlantic in machines of the present day, for the oversea flying course will be practically one third of the distance which machines entering the transatlantic race would be expected to cover. For a long stretch the aviators will have to fly without any land in sight, relying only upon the compass. The aeroplanes entering for the race will be required to carry wireless outfits capable of transmitting signals to a distance of 75 miles.

France as an Aeroplane Power—A serious controversy has arisen in France, which is the direct outcome of the great national aeroplane subscription inaugurated two years ago, and as a result of which 208 aeroplanes were presented to the French army Of these, all but 33 were in active use at the end of last October. These aeroplanes were an addition to the direct orders placed by the army. It is alleged that the aeroplanes bought through the national subscription were not new, and that the orders for new machines fell short by 200 of the number voted. The National Committee, of course, repudiates the charges indignantly, but the French newspapers seem to think it only too probable that certain manufacturers did, in fact, seize the opportunity to dispose of machines not of the most recent and improved type. The investigation started by the National Committee at least served the purpose of calling attention to France's aeroplane strength. In the first year 320 aeroplanes were delivered at the depot at Chalais-Moudon, while the definite orders placed for 1913 amount to a total of 431, of which 286 had been delivered at the end of October last and the balance by now. As a result, 751 aeroplanes have been acquired by the aeronautical establishment of the French army during the past two years and close upon 1,000 machines since the beginning of 1911 Blériot alone has built 181 military machines and Henry Farman 105. No wonder that France has a real aeroplane industry!

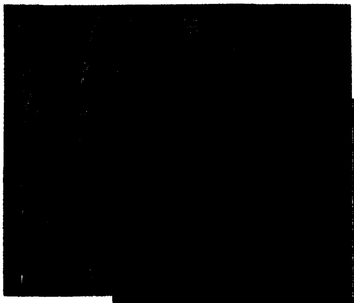
The Plumbing of the Human Body

The Surgeon as a Sanitary Engineer

IN the history of every science we can point to certain landmarks, milestones as it were in the road of progress, which stand out prominently from among the general level of gradual advances. Such epochs mark the ushering in of a new era, the opening out of a new horizon

Has such a point been reached in contemporary medicine? As much has been hinted by some members of the medical profession, and only the future can show to what extent their anticipations will prove warranted by subsequent developments

If we look back to the early days of the history of medicine we find a very crude hypothesis, the humoral theory, forming the basis of medical teaching and practice. According to this, the cause of disease lies in the human economy, *in which the balance between the four* "humors" has in some way become disturbed. Remnants of this speculation are still found in our everyday language, in such expressions as "melancholic" or "choleric" temperament—since the humors (Greek chole, bile) were supposed to determine a man's temperament.



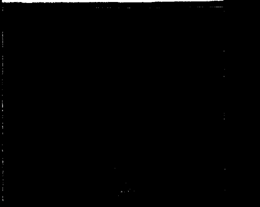
By courtesy of Woman's Medical Journal

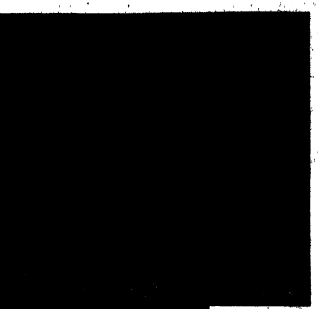
Fig 1—View showing caecum and appendix in normal condition Compare the condition shown in view opposite

Sir W. Arbuthnot Lane, Bart.

Originator of the "Lane Plate" for joining together the broken ends of fractured bones.

By courtesy of Bibliographies of Guy's Hospital Men





By courtesy of Woman's Medical Journal

Fig. 2.—(*A*) Lane's band, producing (*B*) ilial kink. (*C*) appendix caught in band. (*D*) dilated caecum. Compare normal organs in view opposite.

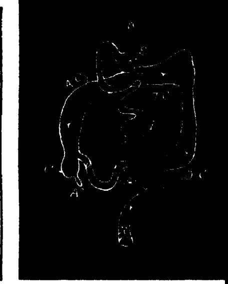
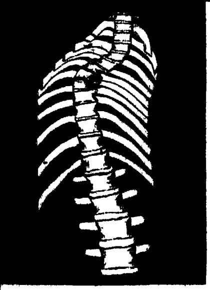
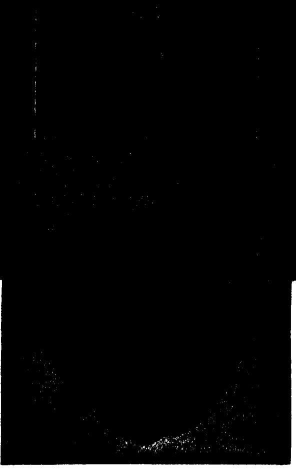


Fig. 3—Diagram of Lane's method of short circuiting out the entire colon from the alimentary tract. *S*, stomach, *I*, small intestine, *C*, caecum; *A*, appendix; *AC*, ascending colon, *TC*, transverse colon; *DC*, descending colon; *R*, rectum The broken lines indicate artificial connection made by operation



By courtesy of Proceedings of Royal Society of Medicine

Fig. 4.—The spinal column of a brewer's drayman, showing deformity produced by habitual carrying of load upon one shoulder. An illustration of nature's efforts to adapt the body to new conditions.



By courtesy of Proceedings of Royal Society of Medicine

Fig. 5.—Elbow joint of a coal trimmer.

Since the days of Pasteur we have become accustomed to seek an external cause for many diseases, which owe their origin to bacterial infection

But this is only a partial solution of the problems presented by disease, for it is well known that we all daily take into our bodies countless microbes without suffering any observable ill effects.

In fact, microbes have little or no terror for the man "in perfect condition"—before they can gain a footing the ground must have been in some way prepared for them, there must be "predisposing" circumstances. This, of course, has long been well understood, but it would seem that one very important predisposing factor has not been fully appreciated or traced to its ultimate source. True, it has always been realized that disturbances in our alimentary tract were responsible for many more or less grave consequences and predispositions for disease True, also, that Prof. Metchnikoff in particular taught very emphatically the deep significance of fermentative changes going on in the intestine, and their probable relation to the premature "ageing" of the individual.

But if the views now put forward are substantiated by further evidence, it would seem that one of the dominating factors producing many of the disorders of our alimentary tract, with the far-reaching consequences in their trail, had not hitherto been properly appreciated. This factor is in the first instance purely mechanical, and relates to the manner in which the intestine is held in place in the human body.

It must be remembered that the upright posture of man is presumably a somewhat late acquisition in the progress of his evolution. There are indications that various structures of the body, and in particular the abdominal viscera, have not yet fully become adapted to the comparatively new conditions of erect posture. How far unusual mechanical stresses may go in modifying anatomical structures will be seen from one of the accompanying illustrations, which shows the spinal column of a brewer's drayman, twisted all out of shape to meet the "new conditions" of the stresses produced in the habitual carrying of a cask on the right shoulder. Another engraving shows the elbow joint of a coal trimmer. It has become much strengthened by buttresses of bone which increase the area of the articular surfaces and render the fit more accurate.

These advantages have been gained at the expense of an abnormally limited range of flexure, the photograph showing the arm in its limiting position.

These are examples of some of the changes produced in the human anatomy by nature's efforts to meet new and unusual conditions As is clear from the illustrations given, the result is far from being wholly happy—an advantage is gained at the expense of some more or less undesirable deformity. And what has this to do with disorders of the alimentary tract? The connection is obvious enough once it has been made clear, as it has been by the labors of Sir Arbuthnot Lane. Nature, in its effort to afford adequate support to an intestine deprived of its original resting base, the abdominal wall, produces here and there special supporting bands—crystallizations as it were of lines of force, lines of tension—to suspend certain loops of the canal. If the matter stopped there, all might be well. But under undue stress, caused by injudicious attire or mode of living, these bands gradually outgrow their proper limits, and instead of being merely supporting members, and thus useful, they become distorting members, causing the intestine to become kinked, and rendering the passage of material through it more and more difficult. Thus, according to Lane, arises the condition technically known as intestinal stasis. The plumbing of the human body is out of order and stagnant. Poisons, toxic products, which ought to be discharged, are retained in the body and produce effects manifesting themselves in a great variety of ways.

As regards the harmful influence thus exerted, Sir Arbuthnot Lane, in an address delivered at the North East London Post-Graduate College, says:

"Perhaps the best scientific confirmatory evidence I can put forward of the harmful effect of defective drainage, both of the body as a whole and of the several tissues which constitute it, has been afforded recently by the remarkable experiments of Carrel in the growth of living tissue, in which he has shown that tissues are immortal, and grow to the greatest advantage if the drainage of their toxic products is carried out effectually."

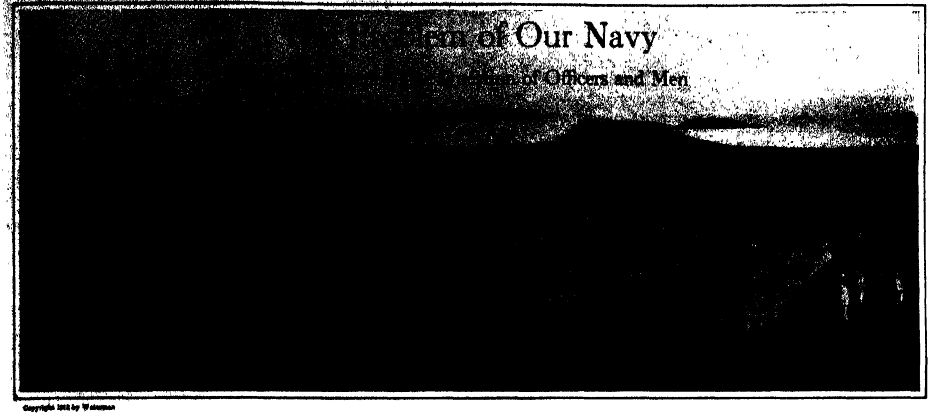
The field thus opened up by Lane has been entered by a number of prominent members of his profession, whose findings seem to substantiate his views. Says Dr. William Seaman Bainbridge in the *Boston Medical and Surgical Journal:*

"It seems to me that he (Sir Arbuthnot Lane) makes out a very good case for his mechanical or evolutionary theory of the origin of all the adventitious structures which, in his opinion, play so important a part in the production of chronic intestinal stasis. It may be said, however, that much work needs yet to be done before any theory can be firmly established. We are only beginning to explore the field which he has opened to us. The establishment of the existence of these various structures takes us a long way. We have yet to determine more about their origin, and to follow the leads which he has given us with reference to the far-reaching effects of the conditions brought about by the development of these structures. The field, it seems to me, is one of the most alluring and promising which modern medicine and surgery present. It is certainly rich in promise for the many who, otherwise, would be doomed to more or less complete chronic invalidism."

In the diagnosis of stasis, X-rays are most valuable in disclosing kinks in the intestine. The treatment may consist in medication, in "ironing out" kinks by judicious exercise and wearing of suitable belts, or, in more pronounced cases, surgical interference may become desirable. This may consist merely in the cutting of some of the adherent bands, or in extreme cases, the greater part of the large intestine (colon) may be sidetracked, i. e., short-circuited or removed. The colon appears often to be a rather unnecessary and in some cases even a harmful organ, which can well be spared when the need arises.

em of Our Navy

of Officers and Men



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IF we were asked to select the one element of supreme importance among the many which go to make up naval efficiency, we should unhesitatingly name the personnel—the officers and men. In saying this, we are mindful of the fact that in previous articles of this series we have shown that the instruments of war will have a much greater influence in determining the issue of naval battles of the future than they had in the days of sail power and the smoothbore. The highly technical and scientific character of war material—ships, guns, instruments of precision, etc.—undoubtedly has exercised a general leveling effect, and has tended to give *matériel* a greater relative importance as compared with personnel than obtained in an earlier age. While that is undoubtedly true, and no amount of dash and courage can counterbalance a great superiority of the enemy in *matériel*, the fact remains that, when the contending fleets are approximately equal in strength, the issue of the fight will be determined by the judgment and skill of the officers and the discipline and courage of the enlisted men. For proof of this we do not have to go further back than the Russo-Japanese war and the often-quoted battle of Tsushima. In that great fight the fleets were fairly well matched; indeed, if there was any advantage, it lay with the Russian fleet, the leading ships of which represented the most advanced practice in naval construction. Moreover, there was a decided superiority in the number of armor-piercing guns carried by the Russians.

But on the Japanese side the ships were manned by highly trained and experienced officers and thoroughly disciplined crews, whereas the personnel in the Russian fleet consisted of officers of little experience in naval maneuvers and the enlisted force was largely made up of absolutely untrained crews, many of whom were making their first voyage in a warship. The result was inevitable, and the really excellent first fighting line of the Russians, poorly maneuvered and unable to either seriously hurt the enemy or to present that defense which a well-directed fire always offers, was completely overwhelmed in one of the briefest and most sweeping victories recorded in all the history of naval warfare.

The preceding articles of the present series on our Navy have been so largely critical that it is with relief that we turn to a phase of the question in which we can speak of the Navy in terms of unqualified commendation. It is our belief that the personnel of the United States Navy, as regards both the officers and the men, is the most efficient to be found in any of the navies of the world. As a people, from the very beginning of our history, we have shown a peculiar aptitude for the sea; and this is true both of the Navy and of the merchant marine. Our clipper ships of the middle period of the nineteenth century were the fastest and most ably handled of any that have ever sailed the seven seas; and in the war of 1812 it was proved over and over again, in many a hard-fought duel, that, under equal conditions, ship for ship and crew for crew, we were more than a match for the enemy. *Whenever the Congress has given our Navy a chance and treated it with reasonable liberality in the provision of ships, officers and men, the Navy has responded most nobly to the call, and in all the history of the republic there are no pages which are read with more justifiable pride than those which tell of the exploits of our individual ships upon the high seas.*

One does not need to have a very intimate knowledge of battleships, torpedo boats, submarines, and of the complicated duties involved in the command of a warship, and in the maneuvering of squadrons and fleets upon the high seas, to realize that the successful discharge of the duties of a naval officer imposes a strain upon his physical and mental powers, so great that it can be successfully endured only by men of exceptional physique, training and ability. From the time of his graduation from Annapolis, the naval officer, whether as ensign, lieutenant, commander, captain or rear admiral, has imposed upon him duties which for their successful fulfillment will make heavy demands upon his physical and mental equipment. His rise in the service will depend upon his ability and zeal, and upon the nature of the service regulations which are made for passing him up from grade to grade as he rises in rank. His zeal and abilities are personal to himself; but the service regulations, so far as they govern his rise, are arbitrary. As matters now stand, the regulations for the promotion of officers are extremely faulty; for they tend to keep him so long in the lower grades that by the time he is promoted to the command of squadrons and fleets, he is long past his prime, and therefore is not able to do justice to himself or to the service under the very exacting duties and graver responsibilities that have come upon him.

The admiral who leads into battle a fighting line of twenty dreadnoughts is responsible for 20,000 men and $200,000,000 worth of the nation's property, which, through his momentary indecision or error, may be destroyed in an hour's time and would take many long years to replace. A rear-admiral is responsible for $50,000,000 worth of property, and each captain for $10,000,000. Weighed in the monetary scale, the responsibility of these officers is enormous The financial loss in the event of defeat, however, is insignificant compared with the fact that the annihilation of that battleship line would mean for the United States the complete collapse of our foreign policies, the loss of our insular possessions and a blow to our lately-acquired prestige as a leading world power, from which it would take us many a long decade to recover. Evidently the men who hold command rank, all through the grades from lieutenant-commander to admiral, should represent the very cream and flower of the service. They should leave each grade thoroughly equipped with the knowledge and facility which can be gained only by serving the term of years incidental to the various grades, as they pass through them. Furthermore, the naval officer should be possessed of that almost instinctive quickness of perception and action, which can result only from years of experience in that particular grade in which he is serving when the critical hour of battle arrives.

Are the conditions which govern promotion among the officers such as will secure the above results?

They are not; for unfortunately the present laws as determined by Congress are not such as to bring the best of our officers to the upper grades sufficiently early in their lives to give them that combination of mental and physical vigor and ripe experience which is necessary to make them fully efficient.

The total number of line officers and the number in each grade are determined each year by Congress; and there is no prerogative of Congress which it guards so jealously and with regard to which it is so sensitive as that of fixing the number of our land and naval forces. Thus, for the present year Congress has determined that there shall be 18 rear-admirals, 70 captains, 112 commanders, 170 lieutenant-commanders, 800 lieutenants, and 350 junior lieutenants and ensigns Entrance to the Navy is by way of the naval academy at Annapolis, and entrance to Annapolis is by appointment under a law which grants to each Congressman and each Senator the privilege of appointing two young men to the Academy. Also forty are appointed each year by the President.

Now, under this arrangement the Naval Academy is sending into the service from 150 to 160 graduates per year That is the supply; and every one of these young men, as he leaves the Academy, should have a reasonable expectation that he will rise steadily by merit and promotion from grade to grade, until he reaches command and flag rank, that is to say, the rank respectively of lieutenant-commander and admiral.

It is evident that, since Congress limits, each year, the number of officers in each grade, promotion from the lower ranks can proceed only as fast as vacancies occur. These vacancies are due to retirement on account of age (62 years) or to death, disablement, resignation, dismissal, and other causes The total vacancies from all causes amount to not over 50 per year. Hence, we have a situation in which line officers are entering the service at the bottom at the rate of 150 per year, and leaving it at the top at the rate of 50 per year, with the result that there is an ever-increasing congestion in the lower grades

Now the mischief of all this is that, unless the system be radically changed, our ensigns will be about forty years old before they are promoted to be lieutenants, and they will be about fifty years old before they reach the rank of lieutenant-commander, fifty-six years old when they become commanders, and well on the way to the Biblical "three-score years and ten" before they can captain a battleship. From this situation results the serious evil that, when the officers reach the ranks of captain and rear-admiral and are entitled to the command of battleships and squadrons, they have long passed that age in which they would have been most fit, both physically and mentally, to perform the difficult duties pertaining to these commands.

This congestion can be met· First, by applying the principle of the survival of the fittest, and selecting every year the best of the officers in each grade for promotion to fill the vacancies in the grades above; second, by removing those officers that are not selected to a reserve list. Those selected would constitute the "active" list, and from this list would be drawn the officers for the fleet in full commission. Those not selected would be transferred to a reserve list, from which would be drawn the officers for the ships in reserve and for duty on shore

But where shall we find a jury that will have a sufficiently intimate knowledge of the personality and record of the officers to enable it to select for promotion the most competent? Evidently the best judges are the officers themselves, who by close association and observation have an accurate knowledge of each others' fitness and ability. Hence, it is believed that the selection of the officers from each grade for promotion should be made by the vote of all the officers in the grade above. Thus the choice of the best among the lieutenant-commanders should be made by the commanders; of the best among the commanders by the captains.

Now it is evident that the number of officers and men authorised by Congress each year should be determined by the size of the fleet on the basis of the displacement of the ships. The Department should submit to Congress in December of each year a statement of the total displacement tonnage of all battleships and cruisers *of less than twenty-four years of age from the date* of their authorization, of all scouts, destroyers and submarines of less than twenty years from the date of authorization, and also of all ships of the above classes that will be commissioned during the fiscal year beginning July 1st following. The Department should submit, also, a statement of the number of officers and enlisted men that would be necessary to man the fleet, based on an estimate of three officers and seventy enlisted men for each thousand tons of displacement.

It has been suggested that the total number of officers so fixed, each year, shall be distributed as follows: One flag officer to four captains, to six commanders, to fifteen lieutenant-commanders, and to sixty-seven lieutenants, junior lieutenants, and ensigns.

The term of service in the various grades, supposing that the graduate from the Academy is about 21 years old, should be, reckoning from July 1st of the year of graduation: For promotion to junior lieutenant, 3 years; lieutenant, 6 years; lieutenant-commander, 12 years; commander, 18 years; captain, 23 years; rear-admiral, 31 years. This would bring the line officers to flag rank at about fifty years of age.

It is proposed that the flag officers (officers qualified to command squadrons, divisions, and fleets) shall be divided into the grades of admiral, vice-admiral, and rear-admiral, in the proportion of one admiral to two vice-admirals, and to ten rear-admirals.

The scheme for determining the number of officers and men in the fleet, as outlined above, is logical and thoroughly practical, and it should receive the legislative sanction of Congress. The increase in the personnel will bear an exact relation to the yearly increase in the size of the fleet as determined by Congress. Furthermore, it will insure that the officers as they rise from grade to grade, consist of the very pick of the service—a consideration the importance of which it is scarcely possible to overestimate.

Hitherto, there has been no such co-relation between the number of ships that were authorized and the number of officers and men provided to man them, and there has been, at times, a serious deficiency, rendering it impossible to man the ships of the active fleet with their full complements.

With regard to the enlisted force, it is gratifying to find that enlistment in the Navy was never so popular as it is to-day; and there is no doubt that this is in great measure due to the efforts of Mr. Daniels, the Secretary of the Navy, to render the Navy more attractive as a career to the young men of the country. This has been done by the inauguration of a system of instruction under the officers of the enlisted men aboard ship, for which a certain period is set apart each day. "By inspiring the confidence," says the Secretary, "that they will really have the double opportunity on shipboard of mastering a useful trade, and at the same time enlarging whatever academic educational advantages they have had, we will attract the very best of our youth to the Navy. And that is what we want, young men who will enlist in the Navy for the very love of the career, combined with whatever other practical advantages and opportunities there may be that will protect them in a financial way, in case of detachment from the service, by giving them the qualifications to take up a definite line of work

"The plan of instruction on board ship which has just become effective with a view to supply deficiencies in academic education and to providing systematic means by which all enlisted men and warrant officers who need it may receive assistance and instructions in technical branches to fit them for promotion in the Navy, or prepare them for civil trades at the end of their period of service afloat, is classified under two heads, academic and technical, or professional."

It goes without saying that the enlisted force of a navy should be citizens of the country under whose flag they serve, either native born or naturalized, and it is gratifying to learn from the last report of the Chief of the Bureau of Navigation, as shown by the accompanying table, that out of a total of 48,068 men in 1913, no less than 43,367 were native born, and 2,842 were naturalized citizens

We conclude this chapter with two instructive tables, one showing the composition of the personnel of three leading navies of the world, on April 1st, 1913, and the other the naval tonnage built and building in the year 1913-14.

CITIZENSHIP OF THE ENLISTED MEN OF THE U. S. NAVY.

	Native born.	Naturalized.	Aliens declared intentions	Aliens resident in United States.	Aliens non-resident in United States.	Natives of—				Total
						Porto Rico	Guam.	Samoa.	Philippines.	
Petty officers....	14,975	2,014	52	12	15	8	6	6	116	17,204
Other rates	28,392	828	62	106	265	38	71	81	1,021	30,864
Total	43,367	2,842	114	118	280	46	77	87	1,137	48,068

PERSONNEL OF THREE LEADING NAVIES.

	Germany	United States	Japan.
Total number of officers	6,353	2,966	5,246
Total number of enlisted men	60,920	47,496	42,043
Ratio of total officers to enlisted men	1 to 9	1 to 17	1 to 8
Ratio of line, engineer and warrant officers to enlisted men	1 to 11	1 to 20	1 to 9
Marine officers	170	316	None
Enlisted men (marines)	5,826	9,866	None
Total officers and enlisted men	73,269	60,617	47,289
Total number of flag officers allowed	40	18	70
Total captains and commanders allowed	351	182	292
Total other line and engineer officers	2,738	1,471	2,695
Total warrant officers	2,615	697	1,520

We draw attention in the table of personnel to the fact that for the number of enlisted men our Navy has about one half as many line officers and warrant officers as Germany and Japan. The importance of having a large reserve of officers to step into the places of those that are killed or disabled in the course of an action cannot be disputed.

NAVAL TONNAGE BUILT AND BUILDING 1913-14.
(JUNE 1ST, 1913.)

	Germany	United States.	Japan.
Naval appropriation	$111,288,618	$140,736,526	$70,302,662
Amount devoted to new construction	$52,179,113	$35,825,695	$24 144,446
Percentage devoted to new construction	47	25	34
Resultant new construction in tons	267,894	166,210	144,586
Total tons already built	865,984	763,132	471,962
Tonnage built and building	1,133,878	929,251	616,528
Dreadnoughts and battle cruisers built	14	8	2
Dreadnoughts and battle cruisers building	9	6	8
Dreadnoughts (capital ships) (7) and (8)	23	14	10
Pre-dreadnought battleships on hand	20	24	13
Pre-dreadnought armored cruisers on hand	9	11	13
Unarmored cruisers built and building..	43	15	14
Torpedo boat-destroyers built and building No 1	130	66	60
Submarines built and building No 2	32	46	15

Finally, we wish to emphasize the fact that because of the higher pay and better food and accommodations of officers and men in the fleet and ashore, and the higher cost of stores, provisions, navy yards, recruiting, etc., the *fixed charges of* our Navy are much greater than those of any other Of the total appropriation for the Navy, 1913-1914, of $140,736,526, no less than $100,000,000 has to be expended for fixed charges—pay, provisions, recruiting, navy yards, etc.—leaving only 25 per cent, or $35,825,695, available for new construction. Germany, whose fleet is manned by conscription, does not have to set aside as we do some $40,000,000 for pay, and hence, out of her naval appropriation of $111,288,618, she is able to set aside 47 per cent, or $52,179,113, for new construction

The Safe Aeroplane

RECENTLY the *Société Française de Navigation Aérienne* held at the Hotel des Ingenieurs Civils, Paris, a special public meeting in which the question of aeroplane safety and the prize of $80,000 offered for the invention which would most markedly advance safety, were discussed before a large audience composed of leading French experts. A translation of the most significant parts of their speeches seems especially interesting in view of the fact that the SCIENTIFIC AMERICAN anticipated and elaborated in an article on "Recent Improvements in the Aeroplane and What They Mean," on the 24th of January, on this side of the ocean, the novel points of view first revealed in Europe at that meeting.

The first speaker was Mr Archdeacon. After criticising the rules under which the prize was offered, and after calling attention to the fact that to establish safety by tests would be inconclusive if the devices were apparently successful and a crime if they were not, he said:

"The only competition for safety which would not be absurd in theory, could not be truly called a competition for safety.

"It would be held, for instance, under the following rules:

"Apparatus for two men; speed required, 60 miles per hour. Start for all competitors on the same day, for a round trip through France, covering daily 300 miles. Repairs permitted only with the tools and materials or spare parts carried aboard the aeroplane, the time required for repairing to be counted as flying time.

"No mechanic permitted to work at the apparatus except the two aviators.

"Obligation to land on difficult grounds and on an inclosed circle of 120 feet diameter around which a rope is stretched four feet above ground, which must not be broken under penalty of disqualification.

"An analogous rule could be established as to starting on a small area.

"I see, for instance, safety in an apparatus which will not be so very different from actual aeroplanes. It needs a good motor that will never fail, *with an enormous amount of surplus power*, all carried on a machine that is extremely substantial and *permits of a great range between its highest and lowest speeds.*

"Given such an apparatus, our good pilots will fly with it around the world."

Mr. Doutre, of stabilizer fame, the next speaker, said:

"The problem of safety for the aeroplane is complicated and deals with all branches of this novel industry. All progress in any line should be encouraged, for it is from the collaboration of various inventors that the best apparatus will originate, which, progressively perfected, will finally afford a better and better relative security."

The most novel and interesting contribution was that of Mr. J. de Saint Aubin, who substantially said:

"I was happy to learn of the opening of a discussion by the Société française de Navigation aérienne for the purpose of throwing some light on the delicate question of safety for the aeroplane. This really comprises two different problems—safety on the ground and safety in flight.

"If an aeroplane has to fly fast to escape becoming a plaything of the wind and the gusts, it must land at slow speed, without losing any of its lift on that account.

"Therefore, I am compelled to proclaim the absolute necessity of varying the incidence of the wings. Such an arrangement will not only greatly facilitate landing, but its action *during flight can be depended upon for avoiding the accidents which originate from positive or negative accelerations.*

"With wings of variable incidence the pilot can, at the moment of acceleration, regulate the incidence to the speed of the moment.

"With such an arrangement *there is still needed, as a useful accessory, a rudder of enlarged surface*, in order to retain control, no matter how much the speed might be reduced. Aviation owes it to Mr. Paul Schmidt, the very intelligent French constructor, that the problem of variable incidence has entered to-day the experimental stage"

There are now really two great solutions of the problem of safety, which the Jury of the Union for Furthering the Safety of Flight may pass upon as accomplished facts—"looping the loop," and wings of variable incidence.

These mean essential progress for the art of aviation, other things (stabilizers, instruments, etc.) are only accessories.

Conserving Waste

THE reclaiming of waste material in the manufacturing industries of the country often marks the difference between a profitable and unprofitable business.

The Williamsport, Pa., plant of the National Silk Dyeing Company has recently installed the most complete system in the world for the reclamation of pure tin from the waste bichloride of tin used in weighting silk, and it is asserted reclaims a higher percentage of tin than any other dye house in the world. This liquid tin is conveyed in a concrete channel to three large settling pits outside of the dye house, each one of which is thirty feet square and twenty-four feet deep. Baffling boards prevent any current. When the water enters the first pit the tin can be seen in suspension as it settles toward the bottom. The water clears somewhat in the second pit, and the tin is found nearer the bottom.

In the third pit the tin sludge has settled entirely, and can be seen as a whitish mass at the bottom of the pit. By the time it reaches this last stage of its journey as much tin is out of it as can be taken, and the water on top runs off into the river after being purified. From Saturday noon until Monday morning of each week these are cleaned. The tin sludge is then pumped from the pits into a tank at the top of the dye house, and from there run into large presses where practically all of the liquor is squeezed out of it. The sludge is then dried into a tin dross in specially constructed ovens, and then mixed with a suitable flux, heated in a reverberatory furnace, and the pure tin smelted out of it. About sixty per cent of pure tin is recovered in this way.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Problem of the North River Bridge

To the Editor of the SCIENTIFIC AMERICAN:

In connection with the recent agitation for a bridge over the North River, it is a remarkable fact that no doubts are raised any more as to the practicability of the long span of 3,000 feet required from pierhead line to pierhead line. It was not so when the writer first published his plans, proposing that length of span over twenty-five years ago (1888). The necessity for a single span of nearly double the length of that in the Brooklyn Bridge arises from two considerations, which, however, were not accepted as conclusive for many years.

First, the rock foundation underlying the mud bottom of the river is from 250 to 350 feet below water, making the building of piers in the river, if not impossible, yet enormously costly. One single pier in the river would have cost over seven million dollars. That amount would pay for 60,000 tons of high-class steel, which added to the steel required for a bridge with piers in the river was more than enough to build a bridge without a pier in the river.

It is real economy in this case to build the bridge with a single span.

The second reason is that the United States Government would never permit piers in the river, even if the foundations would have been favorable, because of the obstruction to navigation and to the maneuvering of large steamers in and out of their docks.

The plans for a single span were criticised as impracticable and unworthy of serious consideration by engineers who posed as eminent engineering authorities at the time. The attacks upon the feasibility of a single span bridge resulted in the appointment of an engineering commission by President Cleveland when Secretary Lamont was in charge of the War Department (1894). That commission, headed by the late Gen. Charles W. Raymond of the Engineer Corps of the United States Army, after a lengthy investigation, declared a single span bridge over the river entirely feasible, and this had the effect of quieting criticism thereafter.

But while this economic feature of a bridge over the North River is settled, another important feature, which also bears upon its economy, should not be neglected, and that is, that it should be built with two decks, so as to give the largest possible carrying capacity, all of which will surely be needed by the ever-growing traffic.

There should be one deck for highway traffic, which includes roadways, promenade, and track for surface, elevated and subway connections, all of which can be accommodated on one deck within the great width the bridge must have to resist wind pressure. And on a lower deck, there will be room for eight railroad tracks, over which the trunk lines in New Jersey can come into New York. The cost will not be proportionately increased, because the same width of right-of-way and the same foundations can accommodate two decks as well as one deck.

The writer had made plans for such a double deck bridge, the location and construction of which had been authorized by the Government (in 1890) from the foot of 23rd Street in New York to Hoboken and the Heights in New Jersey, as shown in the accompanying view. That location was then considered the best for the needs of both sides of the river. It would not be so now. The bridge was intended to be built with the aid of the railroads in New Jersey. But in 1900 the development of electrical traction had brought submarine tunnels, as competitors, into being. While submarine tunnels are not cheaper, track for track, than a multiple-track long-span bridge over the North River, the tunnels have the advantage that they can be built a pair at a time and can be added as needed, while a multiple-track bridge must be built to final size at once.

The Pennsylvania Railroad did not choose to wait for the other railroads in New Jersey to join it in building a bridge, but determined to come in alone in tunnels to a station below ground, to be connected by tunnels under the East River also with the Long Island Railroad system. This fact stopped the building of a bridge across the North River for the time being.

In the meantime, the improvements in automobiles have been so rapid as to transfer this former vehicle *de luxe* for persons into the vehicle of greatest necessity for street commerce. All street vehicles are now carried across the North River in ferries.

The demand for swifter vehicle communication between New York city and the New Jersey territory opposite becoming louder and more urgent, has led to the demand for both tunnels and a bridge for highway traffic; but the equally urgent needs of the railroads have not yet been considered, mostly for the reason, it appears, that the entire project is yet in an embryonic condition, and has not yet been thoroughly studied. Another reason is that the railroads just now are struggling, under hostile legislation, for their very financial existence, and are not in a condition to assume new burdens of construction, no matter how much needed. But this condition cannot last forever. Saner views among the public and the law makers will ultimately prevail, so that the normal growth of construction and commerce will again go on

In the meantime, the railroad freight terminal problem in Manhattan is before the city authorities awaiting solution. It requires the crossing of the river with railroad tracks either through freight tunnels or over a bridge. A careful study of that freight problem will make it appear that the crossing over the bridge will be cheaper than through tunnels which would have to be nearly three miles long with heavy grades in them

The bridge proposition would then present itself in the following form:

Let the cost of a durable two deck bridge, extending from Ninth Avenue and Fifty-seventh Street in Manhattan to the Boulevard on the edge of the Palisades above the West Shore Railroad tunnel in New Jersey (8,330 feet long) be estimated at seventy-six million dollars, an ample amount (if built by private capital) to cover cost and contingencies of construction, right of way, cost of financing and interest during a construction period of seven years. The annual fixed charges would be:

For interest 4 per cent	$3,040,000
For sinking fund ½ per cent	380,000
For maintenance, taxes, administration	580,000
Total	$4,000,000

One half to be assumed by the railroads and one half by the two States.

The railroads' contribution of $2,000,000 to come from tolls, based upon traffic agreements. The share of each State ($1,000,000) to be paid in the form of a rental under an agreement running for the length of the amortization period (say fifty years). Payment of rental to commence only after completion of bridge. The two States would be entitled to the income from tolls on automobiles and from all local transit cars passing over the rapid transit tracks on the upper deck. For all other street traffic the bridge shall be free, the same as the East River bridges.

The revenue from wires and cables, belonging to telegraph, telephone and electric power companies, (not including those for the railroads or any service on the bridge) and from other sources to be equally shared by the railroads and the two States.

There is very little doubt that on these conditions the bridge can be built by private capital on condition that, when the cost of the work shall have been amortized, the tolls and rentals from railroads and communities shall be only enough to pay for maintenance, administration and taxes.

The great economy of a double-deck bridge over a purely highway bridge is apparent without further argument. Its construction without public funds is not only feasible, but highly desirable and advantageous from every point of view, because it can be built cheaper, better and quicker with private capital than it can be done as a work depending upon public funds The excessive cost and wastefulness of our public works is proverbial. It seems as if it cannot be helped under our systems of city and State administrations When the writer was Commissioner of Bridges of this city, he found it impossible to get construction work done at the same low prices as, for instance, railroad work of the same class. Many other conditions over which engineers have no control contribute to the excessive cost of work with public funds. Everyone of the four existing East River bridges cost 80 to 120 per cent more than the original estimates at the time they were authorized.

The share of the rental of one million dollars from each side of the river would commence only after the bridge is completed, and then it would hardly be felt by the tax payers within the benefited area in each State. In a few years the tolls from the local transit lines over the bridge would cover that rental, so that the taxpayers would then be fully relieved from paying anything. In contrast to such a condition of financing, observe the experience of the city of New York with the ferries to South Brooklyn and Staten Island There is now a deficit of nearly $900,000 a year (it was $896,214.18 in 1912) on the operation of those ferries, which has to be covered from general taxation The present prospect is that this deficit will not become less, but that it will be permanent and growing. The more passengers those ferries will carry, the greater will be the deficit. And a similar condition would probably be in prospect for a North River bridge built with public funds.

Although the traffic over the North River bridge would be ten times as large as to South Brooklyn and Staten Island, there would also be greater expense for maintenance and operation

There is sufficient experience on hand to warrant the view that the cost of that bridge built with public money would be indeterminate, and that its administration would become a duplicate of the deficit-producing Staten Island ferries, before which the city stands helpless.

It is only necessary that the railroad interests combine with the local communities for the construction of the bridge with private capital With a little patience and educational work it can be proved, because it is susceptible of proof that the bridge will mean a decided economy in the transfer of railroad freight as compared with the present method of carfloats

The freight terminal problem and the problem of local freight distribution is now proposed to be studied and worked out by experts for the city administration, with the aid of the Chamber of Commerce and the Merchants' Association of New York city, who have for years endeavored to have the subject thoroughly prepared, so that all future improvements for the harbor and shipping shall be done on a unified plan, of which the bridge over the North River will be an essential feature.

GUSTAV LINDENTHAL.

New York.

Span between towers, 3,100 feet. Height of towers, 650 feet. Width of floor, 150 feet. Capacity: On lower deck, eight steam railroad tracks; on second deck, six electric railroad tracks and one roadway; on third level, promenade.

The first design for a North River bridge, made by Gustav Lindenthal in 1888.

Protection From X-rays in Radiography

The Devices of Dr. Maxime Ménard

By Jacques Boyer

X-RAYS are exceedingly dangerous to scientists or doctors who are exposed to them, either daily or for single prolonged periods. The redoubtable emanations of the X-ray tube cause "burns," located, for the most part, on the hands of the operators. (Fig. 1.) This is due to their exposed position in radioscopic examinations. At times X-rays cause organic lesions of a deep-going character, necessitating, for example, the amputation of a finger or surgical interference of the face or forearm; they may even cause the death of professional manipulators in a relatively short space of time.

Dr. Maxime Ménard has succeeded in remedying this hazardous state of affairs. Thanks to special appliances and gloves capable of absorbing the most penetrating X-rays, he insures not only the absolute protection of the hands of the operator, but also that of the rest of his body. Indeed, the radiographic-room recently installed at the Cochin Hospital, according to the specifications of this erudite physician, is well worth a visit. Let us examine, in succession, the three principal constituent parts of this unique installation, (*a*) the sources of the high tension current supplying the X-ray tubes, (*b*) the protective devices of the apparatus for exploration and examination, and (*c*) the tubes generating the rays.

In Dr. Ménard's installation we find two units for the production of X-rays. One of these, used for radioscopy,[*] consists of an induction coil and an interrupter mounted, with certain accessories, on an oak stand. (Fig. 2.) The other, called the Gaiffe rotary commutator, contained in the cabinet on the left in Fig. 2, consists of a high tension, step-up transformer of the usual commercial pattern, furnishing an enormous difference of potential (160,000 volts) and a high tension rectifier transforming this alternating current into a continuous one which is supplied directly to the X-ray tubes.

We will now enter somewhat into detail with respect to each of these sources of current. The parts of the first are specially designed to withstand the formidable difference in potential obtained in the secondary winding of these coils, corresponding to a spark-gap of 30 to 35 centimeters. It is especially necessary to use an interrupter of particularly sturdy construction, such as the Blondel-Gaiffe mercury turbine The principal part of this piece of apparatus consists of a cone with multiple perforations, its lower extremity dipping into mercury. Upon its axis a motor is mounted. The whole is fixed to a metal cover fitted to a cylindrical tank inclosing the apparatus and hermetically sealed by a rubber gasket This tank is fitted with two taps for the introduction of the gaseous dielectric. When the cone revolves under the impulse of the motor, the mercury rises, by the action of centrifugal force, in the oblique channels of the cone and flows from nozzles in the form of a liquid conducting jet which periodically opens and closes the circuit of the coil with a frequency of 42 or 84 interruptions a second, according to the adjustment.

Besides this, in order to break currents of such considerable volume (50 amperes on the average) these interruptions take place in an atmosphere of illuminating gas which cools the ensuing sparks, and thus prevents the destruction of the metallic blades upon which the mercury is projected.

As to the Gaiffe induction coil, this is about 60 centimeters high and weighs 65 kilogrammes; its windings are submerged in a hydrocarbon insulating fluid of enormous electric rigidity, since a layer 5 millimeters thick of this dielectric resists a tension of 45,000 volts. Moreover, by reason of its viscosity, this substance retains its dielectric qualities to a remarkable degree, in spite of elevations of temperature during the course of operation.

Under these conditions, M. Ménard is able to traverse X-ray tubes with currents of 2/100 of an ampere with a difference of potential of from 70,000 to 80,000 volts. This enables him to make radiographs, as a matter of routine procedure, in a few seconds. But when the necessities of hospital practice demand it, this skillful practitioner turns to the Gaiffe rotating commutator, inclosed in a sort of cabinet (Fig. 2), which enables him to reduce the time of exposure to the fraction of a second.

This cabinet conceals within its interior a miniature electric plant (diagram, Fig. 3) of which the principal units are a high tension step-up transformer *T* and a commutator *M*. The first of these pieces of apparatus, inclosed in a tank of galvanized metal, connected with the terminals *AA'*, transforms the current furnished directly by the alternating circuit and gives to the secondary a tension of 160,000 volts, corresponding to a spark-gap of 30 centimeters. Above the transformer, insulated in the same manner as the induction coil described above, revolves the commutator which rectifies the alternating current. For X-ray tubes should always be fed with a continuous current in order to avoid causing their rapid deterioration.

The synchronous motor *M*, which revolves the commutator, turns with a speed exactly corresponding to the periods of the alternating circuit; consequently, the instant the alternating current reverses its direction, the mechanical rectifier makes its connections with the transformer and the tube in such fashion that the current does not change its polarity on the working circuit (i. e., through the tube) The only fittings projecting from the cabinet are the two large insulated columns, traversed by the high tension wires which it suffices to connect directly with the X-ray tube. A milliampere-meter, connected in series with the tube, permits measurements of the volume of the circulating current.

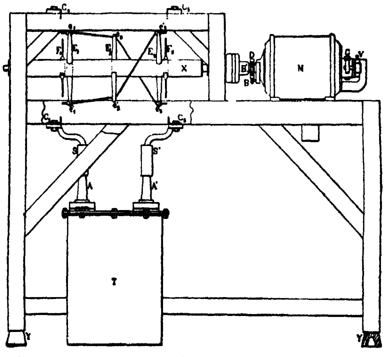

Fig. 3.—Diagram of the Gaiffe rotary commutator contained in the cabinet situated at the left in Fig. 2.

T, transformer; *AA'*, terminals; G_3, G_4, collectors for the rectified current; *M*, synchronous motor; *Y*, shock absorbers. *D*, collector for the clutch indicator

The marble slab mounted on the side of the cabinet seen in one of the engravings (Fig. 2) is used for cutting-in the synchronous motor which actuates the rotary commutator. As to the screen seen on the right of the same picture, this carries the regulating rheostat and serves, at the same time, to protect the operator from the X-rays emitted by the tube. Besides this, a device, termed an automatic cut-out (controlled by a special clock movement which permits the turning on of the current for periods of from 1/5 to 8 seconds as desired) completes the installation.

When it is desired to take a radiograph it is sufficient to close a switch, and the clockwork automatically breaks the circuit as soon as the time determined upon by the operator has elapsed.

Let us now describe the accessories of the radiographic installation of the Cochin Hospital, namely, the supporting standard of the X-ray tube and the exploratory apparatus. Inasmuch as the tube must be susceptible of being placed in any position whatever, so that it may be directed upon all parts of the body, according to the necessities of treatment, its supporting standard is a rather complex piece of apparatus, requiring perfect mechanical construction. In order to protect the operator, the tube is inclosed in a hemispherical shell of insulating material, opaque to X-rays. Metal plates cannot be used to absorb X-rays, in the vicinity of the tube, by reason of grave electrical disadvantages. It has been therefore necessary to turn to insulating materials, such as India rubber, in which heavy mineral substances have been incorporated, showing great opacity to X-rays. This protective shell serves also to carry limiting accessories which serve, when treating a patient, to confine the irradiation solely to the affected part, while protecting the rest of the body. These localizing devices terminate in tubes of crystal, opaque to X-rays, which bar the lateral passage of radiations while permitting the surgeon to observe the part to be treated.

In spite of the considerable weight of the protective shell, the displacement of the tube can be controlled from a distance with the greatest facility by reason of the perfect balancing of the whole. A diaphragm may also be mounted upon the shell which limits the passage of the rays to an opening, variable at will. The control of the diaphragm aperture is effected by means of a flexible connection whose extremity is within reach of the hand of the operator. Thanks to this disposition, the operator is enabled to make all radioscopic observations with a maximum of security. Besides this, a system of barrel springs supports the fluorescent screen upon which the shadows of the viscera are projected and balances exactly its weight. The arm for supporting this screen can be seen at the upper part of the tube standard (Fig. 4).

As to the table upon which radiographs are taken, or radiotherapeutic treatments administered (Fig. 5), this is a simple wooden table which presents the only peculiarities of having an inclinable back-rest and metallic attachments for immobilizing the patient.

But let us now come to the most original part of the radiological service of the Cochin Hospital, the protective device, designed by Dr. Ménard and of which we will borrow the description from the recent communication of this clever practitioner to the Academy of Sciences in Paris. This very ingenious apparatus consists essentially of three panels covered on the inner surfaces with sheet lead of a minimum thickness of four millimeters. Mounted upon a base, they form two wide dihedral angles in whose interior is placed the patient to be examined as well as the Crookes tube.

As is readily noted in the engraving (front page), the central panel is composed of three parts: 1. The fluorescent screen. 2. A movable lead screen. 3. A stationary lead screen. The first can be displaced vertically in grooves, like a sash, by the use of counterweights; the movable lead screen is arranged in like manner and can accompany the fluorescent screen in its movement, or can, on the contrary, be moved away from it.

This mobility of the two screens allows palpation of the patient's abdomen (Fig. 7) and, when once the palpation is concluded, they may again be brought into contact with each other. The patient is placed upon a very easily revolvable platform which the radiologist turns, according to his desires, in order to examine the patient in all pertinent ways. In addition, the fluorescent screen is provided with a covering of lead glass of thickness sufficient completely to absorb Roentgen rays. Finally, this apparatus, which assists the vision of the radiographer because it screens entirely the luminous tube, permits the radiography of the patient in the erect position by reason of the easy substitution of the radiographic plate-holder for the fluorescent screen.

Besides this, M. Ménard has devised protective gloves of an India rubber base combined with metallic salts of high atomic weight (85 per cent of lead compounds) (Fig. 8). With these gauntlets, four millimeters thick, not only the hands, but the wrists of the operator are completely protected from X-rays.

We will now finish our visit to the radiographic clinic of the Cochin Hospital by referring to the X-ray tubes used in this institution. For use in prolonged radioscopy and for radiotherapy, tubes are employed of a capacity of one milliampere; their anticathodes are made of platinum plates upon which the cathode rays are focused. The energy produced by the high tension current is concentrated, in consequence, upon the anticathode, whence an elevation of temperature of considerable degree results, even with currents of very slight

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[*] Radioscopy is the term applied to the direct X-ray examination of a part of the body by means of a fluorescent screen Radiography is the process of taking an X ray picture by means of a photographic plate.—EDITOR.

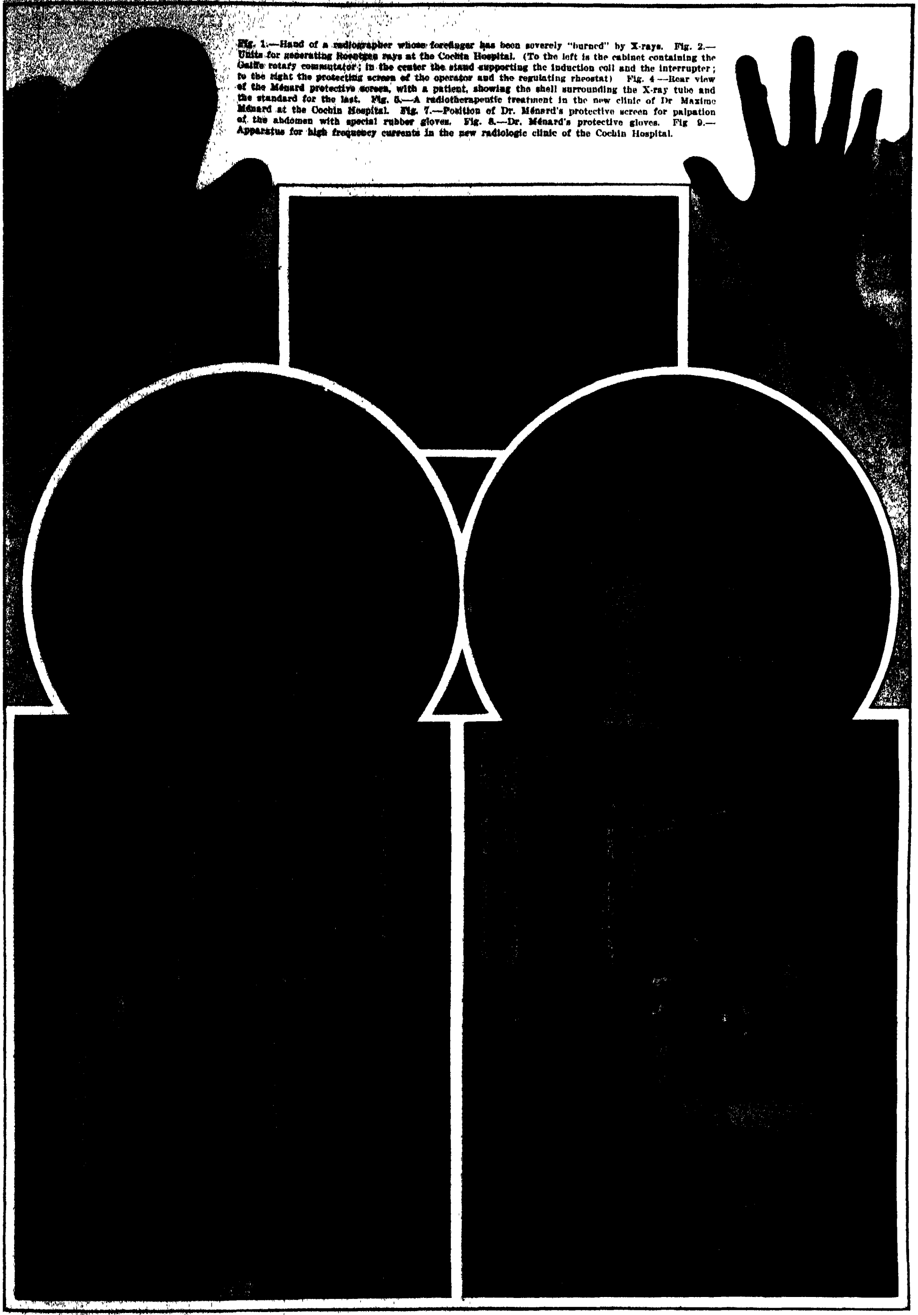

Fig. 1.—Hand of a radiographer whose forefinger has been severely "burned" by X-rays. Fig. 2.—Units for generating Roentgen rays at the Cochin Hospital. (To the left is the cabinet containing the Gaiffe rotary commutator; in the center the stand supporting the induction coil and the interrupter; to the right the protecting screen of the operator and the regulating rheostat) Fig. 4.—Rear view of the Ménard protective screen, with a patient, showing the shell surrounding the X-ray tube and the standard for the last. Fig. 5.—A radiotherapeutic treatment in the new clinic of Dr Maxime Ménard at the Cochin Hospital. Fig. 7.—Position of Dr. Ménard's protective screen for palpation of the abdomen with special rubber gloves. Fig. 8.—Dr. Ménard's protective gloves. Fig 9.—Apparatus for high frequency currents in the new radiologic clinic of the Cochin Hospital.

Various apparatus and accessories for use in protecting scientists or doctors when exposed to the X-rays. The apparatus here shown is to be found in the Cochin Hospital at Paris.

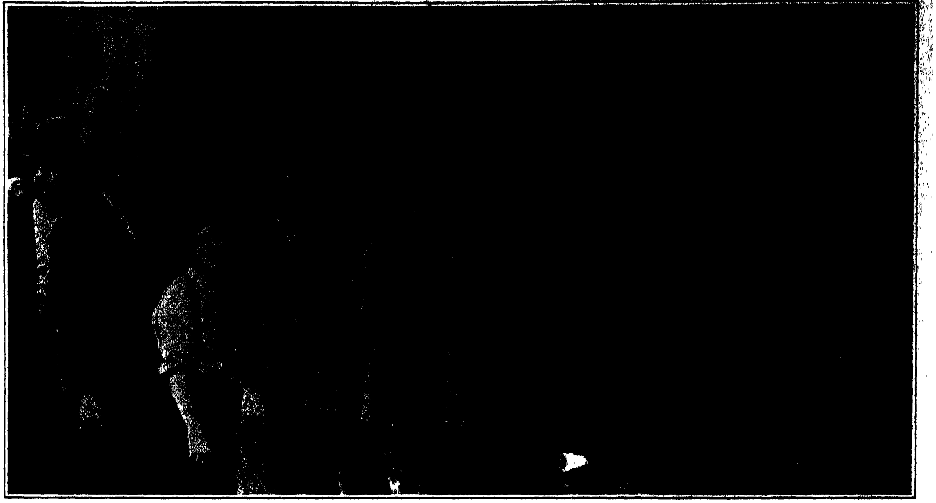

Photo by National Child Labor Committee.

The line of applicants at an Indianapolis factory.

A PAPER-GOODS factory that employs 200 workers, takes from 250 to 300 new employees or "learners" every year. This means that a large part of the cost of operation goes into training workers, or rather "breaking in" workers who do not stay long enough to repay this charge. In a certain large department store that employs regularly 1,000 workers, only about a fourth of the employees remain in the service as long as one year; the average length of service for the rest is about 14 weeks. In a wire factory employing 150 women workers, 450 to 500 "learners" are taken on every year.

An elementary student of arithmetic can see that there is something wrong in these establishments, but these establishments are not exceptional—they are typical. Yet neither the elementary student of arithmetic nor the "average business man" has taken the trouble to find out just what it is that is wrong. The latter has been inclined to blame the schools for sending him "inefficient" boys and girls, and the moving picture shows for making the workers restless, or the "agitators" for making them dissatisfied. The girls and boys for the most part have been too dazed to blame anyone. Perhaps more is to be gained in other ways than in looking for someone to blame.

It is true, to begin with, that the army of girls and boys that leave the elementary schools in the sixth to the eighth grades are extremely "inefficient" from the point of view of their prospective employers. But I am not ready to admit that the demands of these employers should be met by the schools. More than half the children leave at or about the age of 14 years, that is to say, as soon as the laws of the various States allow them to. At this age, most girls and boys are not sufficiently mature either physically or mentally to apply themselves to the sort of routine work that is generally offered to the beginner or the "learner" in most industrial or commercial establishments. That a few of them stick to the first job and work out of it into some sort of a career is fortunate for those few, but is no fair criterion of what we have a right to expect from the many. Nor is it an indication of what opportunities industry offers them. The fact is that most intelligent employers do not care for the young girl or boy, the cost of breaking him in is too great. As a result, the only kinds of work that these young people can get to do are those which are "easy to learn" by watching others, or by being shown once or twice. But these are just the tasks that lead to nothing; in a few short years the girl becomes a young woman, the boy becomes a young man, both without having acquired industrial skill or insight sufficient to bring in a living wage—and they become drifters or even unemployable. That this situation is extremely wasteful from an industrial point of view has been manifest to thoughtful business men for many years. One of the forces back of the movement for industrial education is just the recognition of the waste of potential in the drifting of the untrained workers.

A more dynamic recognition of this waste is to be seen in the scientific management agitation. Scientific management carries a promise of a new industrial revolution—not because it has already brought about an immense increase in the productivity of labor, but because its assumptions and principles are radically different from those upon which most industry in the past has been carried on. Since the beginning of the industrial revolution brought about by the introduction of machinery and factory methods, managements have depended upon expensive machines and cheap workers to produce profits. Closer competition has simply meant the refinement of machinery, the greater division of labor and the speeding up of the worker. Scientific management goes beyond this stage of industry, for it involves almost consciously a social revolution; it has become aware of the "human factor." It has discovered that whereas an individual pioneer may exploit the soil or the forest and leave future generations to take care of themselves, the community as a whole—since its life transcends that of the individual—cannot afford to do so; and it has become active as "conservation." It has discovered that whereas the individual exploiter may squeeze the blood from two or three successive gangs of workers, the railroad, or the manufacturing corporation, which transcends the lives of the individual workers, may not operate on this basis.

The ordinary manager gets what workers he can, any way he can, extracts whatever services from them that he can, and then replaces them with other workers. Scientific management undertakes not only to train each worker for his particular task; it undertakes to select each worker for the particular training. The task of the employment manager is no longer that of counting off so many hands from among the applicants; it is virtually to select pupils for special training within the works or store. It is an application to the human material of the scientific management principle of "efficiency of distribution." It recognizes the fact that to be good economically, a man must be good for *something;* and that one man may be good for one thing and quite worthless for another. It seeks then to put each worker where he will do the most good.

The work of the expert to redistribute the workers in industry is necessary because the workers have come to their jobs in the most haphazard way. This means great economic waste inasmuch as there is a great deal of drifting and shifting, inasmuch as there is a great deal of "internal resistance" involved in the fact that people are trying to do work for which they are by nature *unfitted,* inasmuch as the work lacks enthusiasm. But a still greater waste is involved inasmuch as the casual worker is not a happy worker, does not get from his work those esthetic and emotional satisfactions that distinguish men from machines and donkeys; and the worker who has not found his particular work is a casual worker. But this means most of the workers. Economic efficiency, as well as the higher social efficiency, calls for a more effective distribution of the workers.

The vocational guidance movement, which began to take on a definite form with the work of the late Prof. Frank Parsons (who fished for talents among the young people that patronized the Civic Service House in Boston), has expanded rapidly in a few years and seems now to offer a satisfactory basis for bringing together various forces that ought to work together but that have not been able to find a common working basis. The work started by Prof. Parsons is now continued by the Vocation Bureau of Boston under the direction of Mr. Meyer Bloomfield. In co-operation with employers and with the school system, this form of social service is rapidly assuming a prominent place in the activities of a progressive community. The business man who wanted the schools to give him ready-made office boys and machine operators may find that he can help the schools to giving him something even better. The school man, who was naturally suspicious of the clamor for "industrial education," may find that it is possible to reorganize the school to meet the new demands without losing any of the ideals for which he has stood—indeed, with a good prospect of strengthening the hold of his ideals upon the whole community.

Like all new ideas—like the efficiency movement itself—vocational guidance is exposed not only to a great deal of misapprehension, but also to a great deal of misapplication and abuse. Thus, the phrenologists and astrologers, pressed by science and the spread of education, find in it a new lease of life; for they can add a new high-sounding phrase to their armament of flub-dub and quackery. Or an old-fashioned exploiter looking for the latest wrinkle finds in vocational guidance a quick way for reducing the fee he is perforce obliged to pay to the employment agencies. But vocational guidance is neither an application of astrology nor a substitute for the employment agent. It is simply an attempt to introduce organized knowledge into a field that has been too long left to empiricism and blind chance. It is the effort to give the individual the benefit of competent counsel in the matter of directing his preparation for his major work in life.

Every reader is familiar with the street car conductor who ought to be an opera singer or statistician; you know the physician too, who ought to have become a plumber. Both lacked guidance in making their plans from year to year, while they were young. Surveys made in several cities during the past four or five years have brought out the fact that much of the drifting and floundering can be charged directly to the schools. This is true not because the schools have been inefficient in doing their special work; on the contrary, they have been increasingly efficient in this work for many years past. But the schools have been remiss in that they have not with sufficient alacrity adapted themselves to the changing conditions of social and economic life. Nearly three fourths of the children who leave school when the law allows, do so not because of direct economic pressure in the home, but because the school has lost its grip upon the children. This is to be explained by the fact that the schools continue to give to all the children just that particular pabulum which was satisfactory a generation or two ago to a small fraction—a selected fraction—of the children. But the mass of the children are different from that selected fraction in just this, that they are thing-minded, motor-minded, not word- or symbol-minded, like their teachers.

The result of this failure of the schools shows itself not only in its inability to hold the pupils, not only in the drift and waste of the best years of the children's lives, not only in the subsequent inefficiency—both civic

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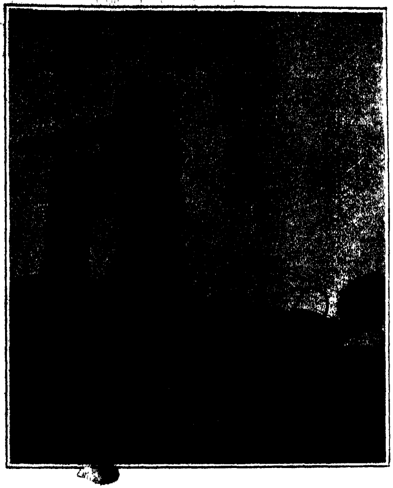
Guns on Aeroplanes

By John Jay Ide

AT the last Aeronautic Salon in Paris were shown several aeroplanes equipped with Hotchkiss quick firing guns. In almost every case, however, the firing arc was extremely limited owing to interference by parts of the aeroplane. Exception may be made in favor of the gun mounted on the Borel monoplane, which had its bow clear owing to the rear position of the propeller. Here again, however, there was an objection in that the gun had to be operated by the pilot, the passenger being placed behind.

The invention of M. Loiseau seems to solve the difficulty of fitting guns to present day monoplanes. As shown by the accompanying photograph, the arrangement consists in attaching the gun to a support braced to the mast and fuselage. The support is high enough to enable the gun to fire over the tractor even with considerable depression. The marksman is protected in front with a shield of four-millimeter armor, and has a light railing at the sides and rear. Granting the efficacy of the shield, the position of the passenger is an extremely exposed one. Also the pilot's view is somewhat interfered with notwithstanding the small sections cut out of the trailing edges of the wings adjacent to the fuselage, which allow him to see the ground. On the whole, however, the gun placing is the most satisfactory possible in tractor screw monoplanes.

The mitrailleuse is fitted to a military type two-seated Deperdussin. Trials commenced February 10th at Villacoublay, near Paris, under the control of Capt. Destouches of the French army. The pilot, Prévost, took up a mechanic to act as marksman. On February 14th the trials were renewed, this time under the observation of Gen. Bernard, Col. Estienne, and several other army officers of high rank. The passenger-marksman was the inventor, M. Loiseau. He operated the gun while the monoplane was on the ground, in full flight and gliding. The accuracy of the shooting while in the air was not remarkable, but it is a mere matter of time before that is obtained. The practicability of operating a gun in this position was fully proved.



The aerial marksman in action.

A Self-steering Farm Motor

By Herbert I. Washburn

THE application of the gasoline motor to agricultural work is of great interest to inventors at the present time. A solution of the question has been obtained for the big farms of the West in the form of the gasoline tractor, but this does not meet the requirements of the irrigated truck farms and gardens of the Eastern and Southern States.

The great need of the country is an efficient helper for the owner of the one-man farm; a machine that will work effectively and make him less dependent upon hired help. No hand steered machine can meet this requirement because the expense of the operator takes $500 per year off the profit of the farm. This was unavoidable with the use of the horse as motive power, but as the gasoline motor is an automatic power source, its correct use requires automatic steering.

Here is a system which has been worked on a practical basis by the writer. It requires compliance with certain mechanical conditions. The farmer who wishes to make use of it must be willing to abandon the old traditions of extensive farming. He must be willing, if necessary, to sell the hillside farm inherited from his grandfather and lay out a new farm to meet those conditions. This is an easy matter with young men just taking up intensive farming, and with those migrating to new localities.

The farm must contain one or more circular areas of any size, up to about ten acres each in area, reasonably level, and irrigated preferably by the tile system. Thus, a farm in central Florida would consist of the usual ten-acre square, with a seven-acre circle in its center, the remaining corners, three acres in area, being occupied by fruit trees, buildings, etc. In the center of the seven-acre circle, the center post shown in the accompanying photograph would be permanently installed. At the top of this post, which is strongly guyed, is seen an iron drum. This drum is indexed and locked by the small handle on the side of the standard. Attached to the iron drum is a slender steel wire, tempered and tin coated. This wire passes through the guide pulley shown, and then to the steering lever of the implement some distance away. At each revolution of the implement around the field, the wire wraps once around the drum, hence the circumference of the drum determines the swath of the implement. Between the frame and the steering lever of the implement a strong spring is attached tending to steer the implement away from the center post. The steering wheel has a deep flange in order to resist side pressure and is mounted in a ball-bearing head. About two pounds pressure at the end of the steering lever is sufficient to guide the implement. Since the tension of the steel spring (and of the steering wire opposing it) is about fifty pounds, the steering lever is obliged to follow an exact spiral path.

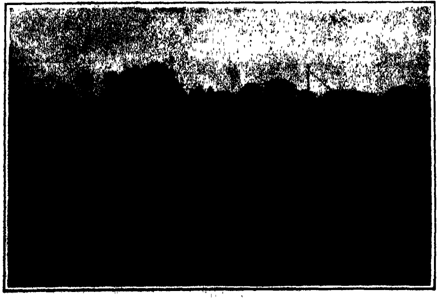
Center post about which the tractor runs.

Repeated runs with the experimental implement shown in the accompanying photograph, starting at a radius of about 200 feet and finishing about 20 feet from the center post, showed no visible variation from the path first struck out A plow jointer was used to indicate this path. A door check was made use of to prevent any undue vibration of the steering lever The slight dancing of the steering wire was desirable, as it obliterated the last vestige of friction in the steering head

The framework of the implement is intended to be such as will facilitate the attachment of all the devices used in row-crop farming, such as plows, ridgers, cultivators, sprayers, etc. Also conveniences for use in connection with hand steering, such as mowing bar, carrying rack, etc.

An improved style of implement has been designed having motive power applied to both rear and forward wheels, both wheels being pivoted so as to work between closely set rows of plants. About 90 per cent of the weight of the machine is on the two drivers, giving a strong adhesion. The remaining 10 per cent weight is on the wheel at the end of the beam. The height under the beam is about three feet, permitting the cultivation of truck, tobacco, cotton, etc., of that height A safety device is provided to stop ignition in case of breakage of the steering spring or wire.

The steering action of the tractor was found to be very dependable in the experimental runs, requiring no attention whatever. The unwinding of the wire from the drum is accomplished while the implement is being run out of the field by hand steering. The steering wire is then suspended ready for use at the next operation. With a dependable gasoline motor, having a positive lubrication, etc., two six-hour runs per day, without an attendant, are possible, placing the farmer on an equal footing with the manufacturer, with his automatically-fed, power-driven machines.



Gasoline tractor that runs a spiral course without an attendant.

Fodder Equivalents

COMPARATIVE tables of the nutritive value of various foods, and the proportions of proteids, fats, and carbohydrates they contain, have long been available for students of human dietetics. That similar tables would be equally valuable to breeders of domestic animals is obvious According to *La Revue* (Paris) such tables are now furnished by Prof. Mallevie, who holds the chair of zootechnology in the National Agronomic Institute of France

"For the first time we are in possession of fodder equivalents. We now have a precise knowledge of the value to horses or cattle of definite quantities of hay, straw, clover, flax-seed cake, and beets, in what measure they can be substituted for each other to attain the same result and what economy or other advantage may result from such substitution"

M. Mallevie shows that 6 pounds of meadow hay give the same alimentary result as 12 pounds of wheat-straw, 2¾ pounds of wheat bran, 22 pounds of beets, 5½ pounds of clover hay, or ½ pound of flax-seed cake.

"These figures indicate what he calls the unit of fodder His table shows how, in default of one equivalent, another may be used without inconvenience, quantities being combined according to circumstances."

Breeders will thus be enabled to compute profits more definitely, and can find by experiment what food gives the largest returns in meat, milk, butter, etc With reference to its cost, it should be remembered, however, that two animals fed on the same ration may vary in power of assimilation, so that one will extract better results per kilo than the other.

Duplicating Charts by Zincography.—The United States Hydrographic Office has recently installed a plant for the reproduction of foreign charts by zincography The hydrographer states in his last annual report that this work will occupy at least four years, but when it is completed the Navy will be practically independent of foreign sources of supply for charts.

A Great Telescope for Canada

THE Canadian government will soon possess a more powerful reflecting telescope than any now in existence. It has been referred to in the newspapers as "the largest telescope in the world," but this description is misleading for two reasons; first, because its aperture, 72 inches, is to be the same as that of the famous Parsonstown reflector, built by Lord Rosse in 1842; and second, because by the time the Canadian instrument is completed it now seems likely that the 100-inch reflector which has long been under construction for the Mount Wilson Solar Observatory will also be ready for use. The Canadian telescope will, however, be a much more efficient instrument than Lord Rosse's. Not only will the mirror be much superior, but the mounting will enable the telescope to be worked to the full advantage. The Parsonstown reflector has an altazimuth, not an equatorial, mounting, and is operated under such difficulties that comparatively little use has ever been made of it.

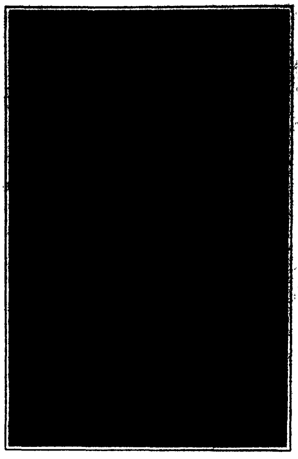
Contracts for the new telescope have just been awarded to J. Brashear for the mirrors and other optical parts, and to Warner & Swasey for the mounting. The disk for the principal mirror will be made by the St. Gobain glass works, in Paris, but all the grinding and figuring will be done in this country. The total cost will be *nearly* $100,000. Inasmuch as the instrument is intended primarily and notoriously for work of no immediate practical benefit, viz., the spectrographic measurement of radial stellar velocities, this sum represents a very notable contribution to pure science on the part of a government.

The telescope will have a parabolic mirror of 72 inches clear aperture and 30 feet focal length, with a central hole 10 inches in diameter. The mounting is to be similar to that of the Ann Arbor and Melbourne reflectors, with a skeleton tube at one side and nearly midway between the bearings of the long polar axis, the balance being restored by the declination motion mechanism and by counterweights at the other side. Both polar and declination axes will be carried entirely on ball or roller bearings, in place of the usual plain bearings for collimating and a complicated system of counterweighted rollers for relieving the friction. The construction will also be simplified in other respects, e. g., all fine circles will be omitted, as will the slow motion arm in right ascension. It is characteristic of twentieth century technique in astronomy that, although the new telescope will have a full set of oculars for visual observations, no programme of visual work is contemplated. Nowadays the camera takes the place of the human retina. The main purpose of the instrument will be the measurement of motion in the line of sight of stars fainter than the fifth magnitude; a task beyond the light-gathering power of nearly all existing telescopes. For such work the telescope will generally be used in the Cassegrain form; the light from the main mirror, converging toward a focus, will be received by a second hyperboloidal mirror of about 19 inches aperture and 10 feet focus, placed about 23 feet above the main mirror. The light passes thence down through the hole in the main mirror, and the star images are formed about three feet below the latter. Here the spectrograph will be placed. For the fainter stars of low dispersion the spectrograph will probably be placed at the prime focus. An investigation of the atmospheric conditions in different parts of Canada is now in progress, to determine where the telescope will be located.

Nebuchadnezzar as a Builder

By Edgar J. Banks

PROBABLY the greatest builder the world ever had was Nebuchadnezzar, King of Babylon from 604 to 561 B. C. There is hardly a ruin in Babylonia which does not show traces of his work. Nearly everywhere in Mesopotamia, and even in Persia, are found bricks bearing his name. He delighted in restoring the old temples. He surrounded defenseless cities with walls and moats. He confined the rivers to their courses with huge brick embankments. Shortly before his time Babylon was completely destroyed, and its foundations were scraped into the river, but he rebuilt and enlarged the city. The temples with which he adorned it amazed even the travelers from distant Greece. The walls surrounding it were one of the seven wonders of the ancient world. Fortunately it was Nebuchadnezzar's custom, whenever he built or restored a temple, to write a long description of his building operations upon a cylinder of clay, and to bury the record in the walls that future generations might read of his work. His wish has been fulfilled, for during the past two years several of the cylinders have been discovered by Arabs, and have found their way to Europe and America.



A finely molded burned clay cylinder of the great builder, Nebuchadnezzar.

The inscription is in three columns, with 145 lines of cuneiform writing, and so well preserved that every one of the fifteen hundred wedge groups is perfect.

One of the last of the cylinders to appear, and now in the possession of the author, was discovered by Arabs in a ruin called Wana-Sedoum, or more correctly Wannet es-Sa'dun, a day's journey to the south of Babylon on the Euphrates River. It mentions the ancient name of the place as Marad, and thus another city is *added to the map of ancient Babylonia.* The cylinder is really a truncated cone, 8½ inches high and 18 inches in its greatest circumference. It is of finely molded clay thrown upon a potter's wheel, and built up as if it were a vase without a bottom. The interior walls distinctly show the finger marks of the ancient potter. The walls are very thick. After the cylinder was inscribed, it was burned until the clay became a compact sand-colored stone. The inscription is in three columns, with 145 lines of cuneiform writing, and so well has it been preserved that every one of the fifteen hundred or so of wedge groups is perfect.

The first part of the inscription is familiar, because it is practically a duplicate of the records upon similar cylinders discovered elsewhere. Nebuchadnezzar begins in his boastful way by telling who and how great he is. Then follows an account of the building of the great walls of Babylon "mountain high," and of the restoration of several temples in Babylon and other Babylonian cities, including the Biblical cities of Ur, Larsa, and Erech, and of the tower at Borsippa, which travelers have called the tower of Babel. His account of how the gods instructed him to make a charm against disease, and to bury it in the foundation of the temple, hints at the superstition of his time. His prayer to the goddess Ninharrak shows his piety and command of beautiful language.

The last part of the inscription is of historical importance, for it is new. In it he speaks of restoring the temple at Marad, and ends with a prayer to Lugal-Marad, the local deity of the place. A translation of the inscription is as follows:

"I am Nebuchadnezzar, King of Babylon, the great, the mighty, the favorite of Marduk, the powerful prince, the beloved of Nabu, the ruler who knows not weariness, the protector of the temples Esagil and Ezida, who is obedient to Nabu and Marduk his lords, who does their bidding; the wise Lord, the darling and the joy of the heart of the great gods, the first-born son of Nabopolassar, King of Babylon.

"When Marduk, the great lord, made me the rightful son, to rule the land, to be the shepherd of his people, to care for the city, to rebuild the temples, he bestowed upon me his great power. Tremblingly I was obedient to Marduk, my lord. I completed Imgur-Bel and Nimitti-Bel, the great walls of Babylon, his mighty city, the city of his exalted power. At the entrance of the great gates I erected strong bulls of bronze, and terrible serpents standing upright. My father did that which no previous king had done. With mortar and bricks he built two moat walls about the city, and I with mortar and bricks built a third great moat wall, and joined it and united it closely with the moat walls of my father. I laid its foundations deep to the water level; I raised its top mountain high. I constructed a moat wall of burned brick about the west wall of Babylon. My father built the moat walls of the Arahtu canal securely with mortar and brick. He built well the quays along the opposite shore of the Euphrates, but he did not finish all his work. But I, his first born son, the beloved of his heart, built the moat walls of Arahtu with mortar and bricks, and joining them with the moat walls of my father, made them very solid.

"Esagil, the wonderful temple, the palace of heaven and earth, Ekua, the temple of Marduk, the lord of the gods, Ka-hilisug, the dwelling place of Zarpanit, Ezida, the temple of the king of the gods of heaven and earth, I clothed with shining gold, and made bright like the day.

"Ezida, the favorite temple, beloved of Nabu, I restored in Borsippa. With gold and jewels I made it beautiful like paradise. I overlaid with gold its great beams of cedar, and arranged them by three to cover Emahtila, the shrine of Nabu. I rebuilt and made lofty Emach the temple of Ninharsag, in the center of Babylon. . . .

"I did a thing which no king before me had ever done. To the west of Babylon, at a great distance from the outer wall, I constructed an inclosing wall 4,000 cubits in length about the city. I dug its moat to the water level. I walled up its sides with mortar and burned bricks, and I united it securely with the moat wall of my father. Along its edge I built a great wall of mortar and burned bricks mountain high.

"I rebuilt Tabisupurshu, the wall of Borsippa. To strengthen it, I built the wall of its moat about the city with mortar and burned bricks. In Borsippa I rebuilt the temple to Tur-lil-en, the god who breaks the weapons of my foes. Ebarra, temple of Shamash in Sippar, Eanna, temple of Ishtar in Erech, Ebarra, temple of Shamash in Larsa, Egishshirgal, temple of Sin in Ur, the sacred temples of the great gods, I restored and completed.

"The support of Esagil and Ezida, the rebuilding of Babylon and Borsippa, which

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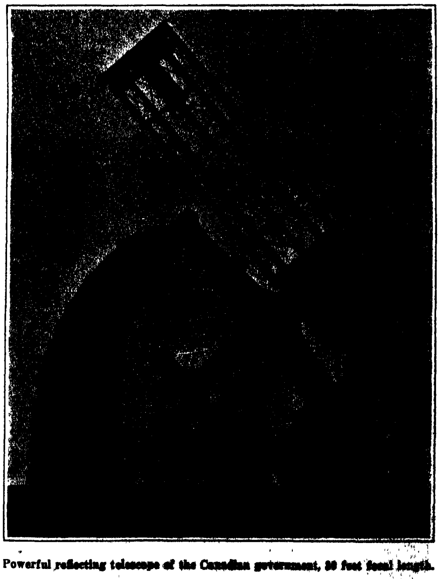

Powerful reflecting telescope of the Canadian government, 30 feet focal length.

The main purpose of the instrument will be the measurement of motion in the line of sight of stars fainter than the fifth magnitude.

Safe Moving Pictures

The Inventions of Nicholas Power

By Arthur J. Lang

Fig. 1.—A cheap moving picture theater, whose frequenters are dependent for their safety on the fire prevention devices which eliminate the hazard of the rapid-burning film.

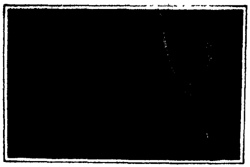

Fig. 2.—The operator of a moving picture machine takes his life in his hands in operating machines not equipped with adequate safety devices or in failing to properly maintain these devices in service when operating modern high-grade machines. The character of operators is a big factor in averting panics, always potential in film theater audiences, as modern conditions require highly intelligent operators.

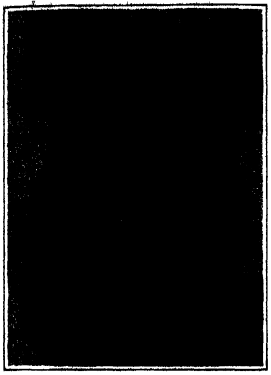

Fig. 3.—The film valve consists of a chute C and four rolls, A, A, B, B. A flame cannot pass the rolls, nor through the chutes to the film magazines.

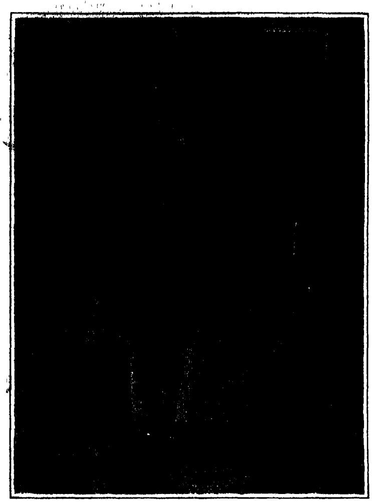

Fig. 4.—A characteristic type of improved electrically-driven motion picture machine in which fire hazards have been minimised and various projection faults (flicker, etc.) practically eliminated.

Fig. 5.—How the film is protected above and below the aperture by the shield U, the shield L, the guard plate G. Lever O used to pull loop.

EVERY day nearly ten million persons flock to the film theaters in the United States. The pictures that flicker before their eyes are photographic images imprinted in strips of film that if ignited burn with the explosive rapidity of smokeless powder. These strips of film move across a stream of concentrated light while pictures are being shown, light so powerful that the rays if focused on a surface of wood could bore into it with the speed of a flame. Were it not for its rapid movement the film would blaze up immediately if the light were not cut off.

Yet films ignite in projecting machines but rarely, if ever, in this country; at the worst, mere holes burned in the strip. A picture or two is cut out, and after the clipped ends are cemented together, the film is ready for another run.

But in other countries south of the United States and abroad, the results of film ignition in projecting machines have been far more serious. Recently fifty-eight children, sixteen women and one man were killed in a panic precipitated by the ignition of a film in a picture theater in Surabaya, Java. One hundred and thirty-one persons, chiefly children and women, were killed and injured, May 27th, 1912, in a film show in Villareal, Spain. The picture machine was not equipped with a take-up reel, and as films were run through the machine they were allowed to pile up on the floor. The film carrying the final pictures of the performance caught fire and ignited the heap of other films on the floor. Since then a number of other horrors of a similar character have occurred abroad, and in the Latin republics of Pan America. But the United States has been singularly free from catastrophes of this sort and magnitude during recent years. The chief reason is that more progress has been made here than in other countries in perfecting the safety features of projecting machines that minimise, or eliminate entirely, fire perils in films. Much of that progress is due to the inventive genius of Nicholas Power of New York.

A motion picture machine comprises two parts: A source of light (the lamp), and the mechanism for operating the film (the machine head). Manifestly safety lies in keeping the inflammable film away from every possible source of ignition, and so closely confined within the machine head, that if ignited by the rays of light, the film will not burn more than a few inches at the worst.

In the early machines films were anything but closely confined. In the "spool-bank" type used until 1896 the film passed over and under the lamp house to and from a box containing series of spools upon which it was threaded. At that time films were made only in lengths of seventy-five feet with ends jointed together, forming endless belts. Frequently the films would touch the lamp house and promptly ignite. After a number of such accidents the belts of film were laid in glass-covered wooden boxes mounted under the machine head.

When longer films began to be used they were wound on reels. A film to be shown was wound on a reel mounted on a bracket clamped to the top of a machine head. As the film was run through the machine, it was spilled on the floor under it. Not only did spilling the film add to the fire peril, but the film itself was scratched or broken and the pictures damaged. Even in New York city in the days when motion pictures "chased" vaudeville performances in large theaters, it was not an uncommon occurrence for films to fall over the rails of balconies, behind which projecting machines were located, into the crowded auditorium below.

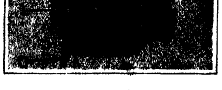

Fig. 6.—The shutter S automatically closes and cuts off the light when the machine stops.

To preserve the pictures some machines were fitted with bags hung so as to receive the films as they were run out. In some cases films were wound by hand on take-up reels instead of being spilled in bags.

In 1904 Nicholas Power devised a take-up or rewinding reel that would automatically vary its speed in proportion to the increasing diameter of the circle of film as it wound on the reel, the speed of the reel being greatest at the initial operation of winding and automatically decreasing as the film wound up, so that the tensional strain would be uniform throughout the winding

Power's take-up device comprises a spindle, which carries the reel, and the driving pulley which is driven by a belt from the machine-head mechanism. The pulley is composed of two separate plates One plate is made fast to the spindle driving the reel, the other rotates loosely on the spindle, but is held against the face of the driving plate by a spring coiled around the spindle. As the film winds on the reel and begins to pull, the spring on the spindle yields, allowing the driving belt to run on the loose pulley plate and slip in the driving side. Also the device is arranged to be driven by a chain or a gear.

While the take-up device improved the operation of a machine it did not lessen the fire hazard much, as the film was exposed on reels over and under the machine head. Immediately following the development of the take-up device, Power introduced metal magazines (*M*¹ and *M*²) Fig. 4, to contain the feed and take up reels; and to prevent the flames of burning films from entering the magazines, he devised a special form of valve, Fig. 3, which allows the free passage of film in or out of a magazine, but which effectively stops the progress of combustion in a blazing film.

The film valve (Fig 3) consists of an elongated chute *C* and four rolls *AABB*. The upper valve shown in the figure is mounted in the inside lower corner of a feed reel magazine *F*, and the lower in the outside upper corner of a take-up reel magazine *T*. The rolls *A* are fixed guide rolls which keep the film from rubbing against the walls of the chutes The rolls *B* are idler rolls whose journals bear in slots *B*¹ cut at angles so that no other force than gravity will be necessary to hold the rolls against the film, thus preventing tensional stresses. The rolls have outer flanges which press against the margins of the film, so that nothing touches the emulsion or picture surface. It is practically impossible for a film to burn past the idler rolls and their companion fixed rolls, but should that occur the blaze could not enter the chutes.

Machine magazines for film reels *M*¹ and *M*² (Fig. 4) are made of heavy Russia iron in square forms, without solder. The upper or feed reel magazine *M*¹ is mounted on a rigid spider which is attached to the machine head frame. The lower or take-up reel maga-

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RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

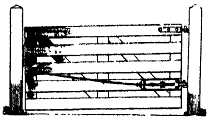
Pertaining to Apparel.

DRAW STRING—BERTHA CLARK, 228 52nd St., Brooklyn, N Y. The invention provides a draw string or band for use in the hem of the gathered waistband of a washable garment and arranged to allow of conveniently and quickly removing the draw string or band prior to washing the garment, and to permit the ready insertion of the draw string or band after the garment is washed.

Of Interest to Farmers.

REVOLVING HARROW.—J. M. BASSLER, Marion, Ohio The improvements in this case are embodied in two circular harrows arranged horizontally and mounted on axes having bearings in draft bars whose front ends are loosely connected by a draft appliance, their rear ends being coupled elastically by a bowed plate spring which serves to hold the peripheries of the harrows in frictional contact, so that the rotation of one aids rotation of the other, which enables the harrow teeth to clear themselves of adhering turf, vines, or other trash Means provide for enabling the harrows to conform more easily to inequalities of the surface over which they are dragged

HINGE—T MITCHELL Oquawka, Ill. This inventor provides an adjustable hinge to be used with fence gates, to compensate for settlement in the gate, or in the hinge post, or to be adjusted for holding the outer swinging end of the gate in raised position to clear any obstruction which may occur in the path of the gate. An object of the invention is to provide adjusting means for the hinge, which may be operated from the outer end of the gate, so that the leverage afforded by the length of the gate may be taken advantage of in raising the gate, while the adjusting means is operated

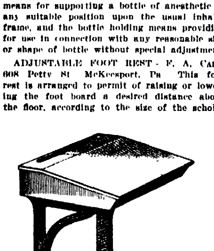

HINGE FOR FARM FENCE GATES.

Of General Interest.

RETAINING DEVICE A Q WALSH, 2 W 47th St, Manhattan, N Y, N Y This invention provides a device for holding fountain pens, pencils, rules, eyeglass cases, clinical thermometers, and similar articles securely in position in a pocket of a vest or other garment while the latter is worn, and arranged to prevent the article from accidentally falling out of the pocket on the wearer stooping or making other bodily motions

BOTTLE HOLDER FOR CHLOROFORM INHALERS - L. DROSIN, 1666 Lexington Ave, New York, N Y. The invention comprises means for supporting a bottle of anesthetic in any suitable position upon the usual inhaler frame, and the bottle holding means providing for use in connection with any reasonable size or shape of bottle without special adjustment

ADJUSTABLE FOOT REST - F. A. CARR, 608 Petty St McKeesport, Pa This foot rest is arranged to permit of raising or lowering the foot board a desired distance above the floor, according to the size of the scholar using the desk on which the foot rest is applied, and to allow of folding the foot rest and swinging the same into vertical position between the standards of the desk and below the table thereof when dispensing with the use of the foot rest or for other reasons


ADJUSTABLE FOOT REST FOR DESKS, ETC

WATER SKEE.—V VOLLER, Bemidji, Minn This invention is in the nature of a water skee, the object being to provide a strong, durable, and safe construction which may be readily propelled through the water and effectively guided in its course. The action is substantially similar to that of skees on the snow, and the knack of actuating the water skee is readily acquired.

TOOTH BRUSH—C. E. CARROLL, Newport, Ark As the formation of tartar begins underneath the gum margin below the necks of the teeth, adheres to the roots and remains as a permanent irritant to the gum, and as no brush in general use is effective in preventing such condition, the present invention has been devised to prevent the lodgment of foreign substances within the free margin of the gums

Hardware and Tools.

LOCK—W MEISS, 1951 Seventh Ave., Manhattan, N Y, N Y. This invention comprises a removable bolt adapted to secure in position a hasp used for fastening a door or the like, a movable member having means for holding the bolt in place, and key-controllable means for actuating the movable member, the last named and the hasp being positioned at the same side of the door.

FOLDING STEP LADDER.—J. DYBECK, care of M Stenabaugh, Box 464, Sault Ste. Marie, Mich. In the present invention the step section is pivotally suspended by a hanger at the top, the hanger constituting a plate spring, and a link connects the step section with the stand or frame below the hanger, the arrangement being such that in the swinging of the ladder to an inner position within the stand, the hanger is placed under tension so as to force the ladder downwardly and by its engagement therewith hold it securely within the stand.

Heating and Lighting.

VALVE FOR GAS BURNERS.—E S ALLEN, 517 W 134th St, New York, N Y. The purpose of the inventor is to provide a valve for gas burners arranged to permit convenient adjusting with a view to regulate the amount of gas passing from the service pipe to the burner and to be automatically closed by a movable member of a stove so that the gas is shut off from the burner

Household Utilities.

BED PAN - A B KNOWLTON, care of Knowlton Hospital, 1515 Marion St, Columbia, S C. The pan is constructed with a central, longitudinal, primary chamber or receptacle and with an overflow receptacle which partly surrounds the primary one, and a third receptacle into which both the others finally discharge their contents Such final receptacle is located at one end of the pan and holds the excreta safely when the pan is carried, in vertical position like a pail, by means of a handle located at the opposite end of the pan The final receptacle is constructed with a flat head or end so that it may be supported in vertical position upon a floor or other flat surface

Machines and Mechanical Devices.

CHRONOMETER ESCAPEMENT—W E. WALKER, Woodstock, Ohio. The purpose here is to provide a detached escapement in which the balance receives impulse direct from the teeth of the escape-wheel, without the use of guard pins, banking pins, or springs, and which will effectively perform its function in the face of hard or rough usage

BOAT PROPELLING MECHANISM—J. B TRESCOTT, care of Wisco Supply Co, 7th and 8th Sts and Clark Ave, St Louis, Mo., and R C Busch, St Louis, Mo. The invention provides motor units arranged for propelling boats; provides means for demounting and remounting units to augment or diminish the motive power for propelling boats or the like; provides a multi unit prime mover for vessels, adapted for temporary installation; provides units for propelling shallow-draft vessels, provides means for harnessing said units to permit shifting thereof for use as aids in steering the vessel, and provides means for harnessing the units to change angle of operation thereof relatively to the keel of the vessel to which they are applied

SCALE—V O. KLINGLER, Slayton, Minn. The principal object of the invention is to provide an improvement especially adapted for use with the scales, whereby the valves will operate more easily, the use of the improvements also tending to save the wear on certain of the co operating parts.

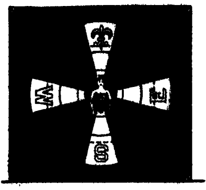
JIGGING MACHINE.—O. H. BOHM and W. M McCOY, Birmingham, Ala Address the former, 725 Sergeant Ave, Joplin, Mo. An object of the invention is to provide a device in which the working parts of the plunger reciprocating mechanism are submerged in oil so as to provide a thorough and constant lubrication, which protects the lubricating oil against contamination by grit, water, or other foreign substance.

Prime Movers and Their Accessories.

ROTARY VALVE.—G P B HOYT, 1 Clinton Place Jamaica, N Y, N Y In this case use is made of a cylindrical valve chamber having parts in its side and an opening in one end, a rotary valve fitting into said chamber and having a port adapted to register with said valve chamber ports, the said rotary valve being split at its port, and an annular partition fixed in the said valve chamber and having ports opposite the said valve chamber ports, the said partition being split intermediate its ports.

Pertaining to Recreation.

ILLUSORY THEATRICAL DEVICE FOR VAUDEVILLE ACTS.—H. J. MOORHOUSE, 335 W. 6th St., Superior, Wis. This invention relates to a stage appliance for use in a vaudeville act to produce an illusory or mystic effect, and it relates more particularly to a device adapted for use in connection with stereopticon, motion or other pictures. The illusion differs from all other attempts, by reason of the transformation taking effect under full white light, without the use of mirrors; and in the area of the picture screen containing only about 50 per cent of picture holding material, or two square feet of picture for each square foot of screen. The illusion is intermixed with acting, music, songs, animated scioptic posing effects and a mysterious fading away of the living image and shield.


DEVICE FOR VAUDEVILLE ACTS.

Railways and Their Accessories.

CHILD'S CRIB OR BERTH ATTACHMENT FOR RAILROAD CARS.—L. W. GEERKEY, Douglas, Ariz. In the present patent the invention is an improvement over that disclosed in Mr. Geerekey's patent, No. 1,055,897, dated March 11th, 1913, and it has reference to an improvement in the means for securing a crib to horizontal rails applied to the inner side of a railway carriage.

PNEUMATIC DERAILER.—J. J. MCINTYRE, care of D B Stauft, care of Taylor Coal & Coke Co., Uniontown, Pa. This invention contemplates positive means for derailing either loaded or empty trains or parts of trains, or "trips" of cars or mine wagons when operating on incline planes or slopes, in order to prevent serious wrecks when cars become detached through accident or otherwise. The invention provides for promptly derailing a runaway car or cars before the same attain a destructive momentum.

AUTOMATIC TRAIN STOP—J S ALLEN, 115 Broadway, New York, N. Y The stop has a hollow post, in which a shaft is journaled, a cap being secured to the shaft, and having depending lugs, which engage stops on the post for limiting the movement of the cap and shaft. The cap extends outward from the shaft, with means for protecting stops and lugs from the weather Secured to the cap is an extending arm engaged by a contact member, carried by arms secured to a shaft, journaled in a bearing on a locomotive or car with means that will rotate the shaft journaled in the bearing in the locomotive or car, to open the valve.

Pertaining to Vehicles.

WHEEL—J PEACE, Ogden, Utah. Address J G Heywood, same place. This invention relates to wheels, and more particularly to resilient treads An object is to construct a wheel in such a manner as to avoid the use of pneumatic tubes and casings, and yet produce a tread which will yield to an uneven surface so perfectly as to produce a pneumatic result.

Designs.

DESIGN FOR A RING OR SIMILAR ARTICLE—W. FISCHER, 45 John St., New York, N. Y In this gracefully rounded ring the setting comprises a number of prongs that clasp a high set disk, in the center of which the gem is placed.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor

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Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12971) L. H. W. says: The original brightness can be restored to pearl articles by first cleaning them with pure olive oil. This penetrates the pearl object and does away with the blurred look Then polish as one polishes a finger nail Apply the polish and rub with a chamois skin.

(12972) L. H. W. Writes: Paint may be removed by the following mixture: One pound of commercial potassium hydroxide is dissolved in 40 ounces of acetone. Then add 20 ounces of methylated spirit, 20 ounces of oil of turpentine, 20 ounces of spirit of petroleum, and 10 ounces of castor oil. Wash off the paint with this mixture, using old rags to prevent mussing. If the paint is thick, a dull knife will aid materially in removing it, while no harm will be done to the wood if care if exercised.

(12973) H. J. G. asks: Will you be kind enough to tell me whether there are any detrimental effects incurred by the moving-picture operator, and if any, how caused? A. We know no reason why a moving-picture operator should be injured by his occupation more than any other man who works about electric lights. The eyes should not be exposed to the arc light directly at all, or certainly not for any length of time.

(12974) S. T. T. asks: In an argument recently with a railroad locomotive engineer, he declared that the top surface on the drive-wheels of an engine travels faster than the lower part of the wheels, but could not explain the fact If this is so, will you kindly send me an explanation? It seems a physical impossibility to me; however, it may be true A With reference to the motion of the parts of a wheel of a locomotive on the track, it must be evident to you upon thinking of it that the part of the wheel which is in contact with the rail at any moment is not moving forward at all, unless it is sliding on the rail, which you know it does not usually do. The top of the wheel is moving forward very rapidly. The bottom of the wheel is at rest on the rail, and the top is moving forward This your friend, the engineer, know, but could not explain It is not a physical impossibility, but a fact The wheel must not slip on the rail if it is to draw the train. If it does not slip, it is of course at rest on the rail at the point where it comes in contact with the rail.

(12975) S. C. S. asks: Inclosed find 10 cents for which send me copy of SCIENTIFIC AMERICAN that has the article in it in regard to making experiments with the *violet ray by using violet-colored glass*. If you can tell me where I could find anything else regarding this, I would like to know where it is A We send you under separate enclosure our SUPPLEMENT No 1920, containing a description of the various filters which have been used for separating the ultra-violet rays from the rest of the wave lengths of light. You can probably obtain the Wood ultra-violet ray filter directly from Prof R W Wood, Johns Hopkins University, Baltimore, Md We would advise that a violet-colored glass will not by itself quench all the rays except the ultra-violet A blue glass should be used with the violet glass for good effects. The choice of tints is also important It is better to get a glass made by a person of experience for first experiments Then you will know that you are producing what you should produce. Besides the SUPPLEMENT named above we have published many papers on this very interesting subject. We name the following: SCIENTIFIC AMERICAN, Vol 102, No. 12, Vol 107, No. 19; Vol 109, No 3, and SUPPLEMENT Nos. 1711, 1762, 1778, 1787, 1807, 1809, 1831, 1845, 1856, 1895, 1953, price, ten cents each.

(12976) D. L. W. asks: 1. I have read that water at 39 deg. Fahr. is heavier than at any other temperature Will you kindly explain why? A Water is densest at about 39 deg. Fahr and expands if either heated or cooled from that point. We do not know the reason why this is so, but it is of the greatest importance in nature. Because of this, ice forms on the surface of water instead of forming at the bottom of lakes and rivers and oceans 2. I have a toadstool which is petrified. Now that it has turned to stone, it is several times heavier than before. Will you kindly tell me where it got the additional weight? A. Your petrified toadstool weighs more than before petrifying because stone is heavier than the vegetable matter which was there formerly. 3 I have noticed more meteors fall to the southward than any other direction Is there any reason for this? A. We know no reason why you should have seen more meteors fall toward the south than toward any other point of the compass. Meteors enter the air from all directions and travel through it. 4. Will you kindly tell me if extremely cold weather will destroy the caterpillars in the brown-tail moth nests? A. The brown-tailed moth seems to get through the winters in the North in good numbers, so you might infer that it can endure the cold of our winter seasons.

NEW BOOKS, ETC.

A Day in the Moon. By the Abbé Th. Moreux. London: Hutchinson & Co., 1913.

The Abbé Moreux, whose contributions on astronomy have appeared in many of the better popular French magazines, has presented in this book a very readable account of the moon. To be sure, his day in the moon means not a twenty-four-hour terrestrial day, but fifteen terrestrial days, in other words, a lunar day. By carrying the reader in imagination to the moon, by exhibiting to him the great craters, mountain ranges, and vast expanses of frozen lava, the Abbé presents his facts in a very vivid way. The book is admirably illustrated. The translation may be commended as a good piece of work.

Handbuch für Heer und Flotte. Enzyklopädie der Kriegswissenschaften und verwandter Gebiete. Herausgegeben von Georg von Alten, Generalleutnant z. D., fortgeführt von Hans von Albert, Hauptmann a. D. Unter Mitwirkung von etwa 400 der bedeutendsten Fachautoritäten. Preis jeder Lieferung 2 M. – 2,40 K. Berlin W 57: Deutsches Verlagshaus Bong & Co.

The 65th, 66th, 67th and 68th installments of the "Handbuch für Heer und Flotte" take up from Kapudan-Pascha to Krasnoje Selo. The more important articles are those on *Karte, Kasematte, Kavallerie, Königgrätz, Kosten und Volkswirtschaftliche Wirkungen der Kriege*, and *Konstantinopel*. Major-General von Werlhof has written an excellent article on *Kasaken* (Cossacks) which bears the marks of much original research.

The Wanderings of Animals. By Hans Gadow, F.R.S. Cambridge: The University Press. New York: G. P. Putnam's Sons.

After tracing the rapid growth of this young science, the author shows how important is the subject of geographical distribution. The home is sketched, particularly the homes offered by tropical forests, deserts and high mountains, so that the various effects of climate and interdependence of animal and plant life may be brought out. Short chapters on the modes, means and rates of spreading show the effect of the natural increase in numbers, the relation of species numbers to individual numbers. How the map of the world has undergone many vast changes, and thus caused animals to readjust their home requirements, is simply indicated Especial portions of the book deal with the distribution of a considerable number of various groups of animals, mostly terrestrial vertebrates, selected for their fitness as test cases.

The Atmosphere. By A. J. Berry, M.A., Lecturer in Chemistry at Downing College. Cambridge: The University Press. New York: G. P. Putnam's Sons.

Meteorology plays no part in this book. Only chemical and physical phenomena are considered, Hence the book discusses the history of atmospheric study, gives a very good account of the principal constituents of the atmosphere. Briefly it reviews modern views on combustion and similar problems. The chapter on the escape of gases from planetary atmospheres according to the kinetic theory is particularly well done.

Primitive Animals. By Geoffrey Smith, M.A., Fellow of New College, Oxford. Cambridge: The University Press. New York: G. P. Putnam's Sons.

This little book well fulfills its object of presenting a simple account of modern views on the relationships of the chief groups of the animal kingdom, the principal grounds on which the modern classification of these groups may be justified, and an outline of the evidence by which some of the main streams of animal evolution can be traced.

Rocks and Their Origins. By Grenville A. J. Cole, Professor of Geology in the Royal College of Science for Ireland. Cambridge: The University Press. New York: G. P. Putnam's Sons.

This book is to be regarded as a companion to Mr. E. A N. Arber's "Natural History of Coal," also forming one of the Cambridge manuals of science and literature, for the author has omitted very wisely a discussion of those subjects which Mr. Arber had to take up Hence the author has not taken up the carbonaceous rocks, but he does give a very readable account of rocks in general, limestones, sandstones, clays, slates, igneous rocks and metamorphic rocks.

The Natural History of Coal. By E. A. Newell Arber, M.A. Cambridge: The University Press. New York: G. P. Putnam's Sons.

A more difficult subject than the geology or the palæobotany of coal could hardly be selected for popular discussion. Although coal is one of the most important substances in the world, still science has not yet determined what is the true origin of the material, how it was formed, etc. Hence the book before us is confined very largely to an elucidation of past and present theories.

Young Folk's Handbook. Philadelphia: American Institute of Child Life. 8vo.; 215 pp.; illustrated.

The After School Club represents an organized effort to guide boys and girls into happier and more educative and efficient ways of work and play. Its headquarters are at Philadelphia, but its scope is national, and it takes in young people of all ages. The members are graded, according to age, into "inner circles," each with its own particular interests and activities. The "Young Folk's Handbook" tells all about the club—what it is, what it is doing, how it does it, and why. The progressive sections of the book correspond with the ages dealt with—up to six years, from seven to fourteen years, and from fourteen to twenty-one years. Instruction is given in the exercise of the muscles, the development of regular habits, and the development of the imagination and the powers of expression. A large part of the work is devoted to a bibliography of suitable books, briefly reviewed. Parents and teachers will find both book and organization of immense value, and would do well to make them factors in the lives of their charges.

The Modern Locomotive. By C. Edgar Allen. Cambridge: The University Press, 1912.

The author has handled a very difficult subject with all the simplicity that can be expected. The general principles governing the design and working of a modern locomotive are clearly presented, and the broad lines of development from its comparatively simple predecessor of twenty-five or thirty years ago boldly traced. The thermodynamics of the locomotive engine play a very important part in the book, which is as it should be.

Aerial Locomotion. By E. H. Harper, M.A., and Allen Ferguson, B.Fc. With an Introduction by G. H. Bryan, Sc.D., F.R.S. Cambridge: The University Press. New York: G. P. Putnam's Sons.

Although since this book was written aerodynamic discoveries have been made, notably by Eiffel, which have markedly influenced aeroplane design, nevertheless the work may be recommended as a clearly worded account of the principles underlying the construction and behavior of aeroplanes and dirigibles.

The Physical Basis of Music. By Alexander Wood, M.A., D.Fc. Cambridge: The University Press. New York: G. P. Putnam's Sons, 1913.

An excellent, simply-worded presentation of modern theories of sound. In the space of only one hundred and sixty pages the author has managed to compress all that a well-educated man ought to know of sound and music.

Life in the Sea. By James Johnstone. Cambridge: The University Press. New York: G. P. Putnam's Sons.

Mr. Johnstone has written this popularly worded book on the basis of the German and Scandinavian studies of microscopic life contained in the sea. The German investigation, it will be remembered, was intended to determine the quantity of plankton; the object of the Scandinavian hydrographers was to forecast seasonal changes in the climatic conditions of their countries by studying the currents of the sea The researches conducted by these Germans and Scandinavians have had a marked influence upon marine biology and that influence is reflected in this book.

House Flies and How They Spread Disease. By C. P. G. Hewitt, D.Sc., Dominion Entomologist, Ottawa, Canada. Cambridge: The University Press. New York: G. P. Putnam's Sons.

This little volume will undoubtedly fulfill the hope of its author that it will not only bring home to a greater number of people the true nature of the house fly, but also indicate the means to be taken to eradicate it or render it no longer a menace. The author has done much work in investigating the structure, development and biology of the house fly and therefore writes from first-hand knowledge.

How to Build Up Furnace Efficiency. A Hand-book of Fuel Economy. By Jos. W. Hays. Chicago: Jos. W. Hays. 12mo.; 126 pp.; illustrated. Price, $1.

The writer compels attention from the start; tells you exactly why and how your fuel is being wasted, how to locate the point of waste, and how to stop it and keep it stopped. He is insistent that a full quarter of your coal is being needlessly wasted in burning, and engages to save you a quarter of your coal pile. Starting with the proposition that the most efficient furnace is the one which completely consumes the combustible with the least surplus of air, he shows how to diagnose trouble by the aid of the tallow candle, the flue gas analyser, the differential draft gage, and the pyrometer. His treatment is always popular, often humorous, sometimes whimsical, but it has the true stuff at the core of it, and it presents advice worth following and knowledge worth assimilating.

The Recent Evolution in Organ Building. Being an Account of Modern Developments. By George Laing Miller. New York: The Charles Francis Press, 1913. 12mo.; 192 pp.; illustrated. Price, $1 net.

The organ student will find in this work an illuminating presentation of organ history and of the men who have made that history. The papers are written primarily for the benefit of those who are concerned either in the purchase or the renovation of an organ, and specifications of many of the world's notable instruments are fully given. No organist should be without an understanding of the mechanical principles and the detailed construction of his instrument, and such knowledge is admirably supplied by the monograph in hand. The musical reputation of the author is international, and his qualifications for the task he has undertaken are indisputable

Motion Picture Making and Exhibiting. By John B. Rathbun. Chicago. Charles C. Thompson Company, 1914. 12mo.; 236 pp.; illustrated. Price, $1.

The field of the motion picture is steadily enlarging. From a mere amusement device it is coming to be utilized as a strong educational factor, and in other ways is demanding increasing respect and consideration. Mr. Rathbun's volume, while not so bulky as some similar works on the market, is clear and comprehensive, and demonstrates the author's fitness for the task of imparting his own wide knowledge. Early efforts in motography are reviewed, the modern projector and its accessories are described, and the film is shown in successive steps of its historical development. The actual picture taking is, of course, the subject of several lengthy sections, and the intimate details of studio arrangement and practice are revealed. The writer clearly explains the way in which certain trick films are produced. A portion of the work is also given over to the writing and marketing of scenarios That section of the volume dealing with the exhibition end of the business is quite as lucid and thorough as the chapters preceding, and contains instruction and suggestion that no theater manager can afford to ignore.

The Principles of the Application of Power to Road Transport. By H. E. Wimperis, M.A., M.I.E.E. New York: D. Van Nostrand Company, 1913. 12mo.; 130 pp.; illustrated. Price, $1.50 net.

The ever-increasing importance assumed by road transport carries with it a complication of problems toward which investigation and experiment are constantly leading to higher efficiency, both in the road itself and in the vehicle. Any consideration of resistance to motion on a road must deal with the primary factors of road-and-wheel friction, with the loss of power inherent in the mechanism and with the air resistance These factors are very thoroughly canvassed by the writer, and the most approved methods of determining their extent and of mitigating their drawbacks are explained. Their laws are reduced whenever possible to tables and formulæ Bench and road tests are described and the instruments and devices used are made the subject of illustration. Tractive resistance and friction curves are presented diagrammatically, the result of American experiments are tabulated and discussed; electric, internal combustion and hydraulic systems are subjected to investigation and analysis, and there are several useful appendices including reports on brake horsepower tests at Brooklands, road test report forms, etc. The work is a distinct addition to the somewhat scant literature of its subject.

L'Art de Reconnaitre les Fraudes. By M. Emile-Bayard (Inspecteur au Ministère des Beaux-Arts). Official of the Department of Beaux-Arts. Paris: Roger & Chernowitz. (99 Bd. Raspail.) In-18. 326 pp.; illustrated. Price, 5 francs; bound, 6 francs.

Owing to the experience which the writer has acquired by his long connection with the State Beaux-Arts department, he is well qualified to treat such subjects as the present, and the result is an interesting volume about the various kinds of frauds which are now so largely practised in the production and sale of works of art, antiquities and bric-à-brac He points out the fact that the public is largely responsible for this state of affairs owing to the heavy demand for all kinds of antiquities that is made at present, and this is surely on the increase, so that antiquity itself would not have had the time to produce them. As a natural result, skill in producing "ancient" objects is increasing to keep pace with the demand, and the already great quantity of objects turned out is not likely to diminish. Paris is, of course, one of the centers of the industry. M. Emile-Bayard passes in review the classes such as painting sculpture, old furniture, metal and ivory objects, ceramics and tissues, so that amateurs will be aided in detecting at least certain kinds of frauds though in higher class work the skill in imitating antique objects often baffles even the expert The author has chosen to enliven the book by the use of a literary style which we should have preferred to take for granted, and a condensation of the same would have allowed of devoting more of the work to positive data or at least of anecdotes and local color. Numerous photographs, over a hundred in fact, add much to the value of the book, and it is certainly a welcome contribution to this little-known subject.

Col. J. M. Schoonmaker and the Pittsburgh & Lake Erie Railroad. A Study of Personality and Ideals. By Harrington Emerson. New York: The Engineering Magazine Company, 1913.

As Mr. Emerson developed and applied the principles of efficiency engineering—a profession at the head of which he now stands—the importance of the human element grew upon him He realizes, now, as perhaps very few efficiency engineers do, that while machines may be arranged most effectively, while they may be supplied with material rapidly, while factory buildings themselves may be models in their way, ultimately the man behind the machine must be regarded as the hub of every great manufacturing enterprise. Curiously enough, everything in a modern industrial organization seems to have been closely studied except the human beings upon which its ultimate success is dependent. Hours, days, weeks, and even months may be devoted to a painstaking study of mechanical equipment, but not ten minutes to the men who will be charged with the operation and maintenance of that equipment Mr Emerson was one of the first to insist upon the same care in the selection of human as of mechanical material His later writings have dwelt eloquently upon the necessity of studying a man's aptitudes before entrusting him with work, however important or unimportant He has set up certain human standards and ideals which correspond with the standards and ideals to be followed in selecting and arranging the machines of a factory Human characteristics mean as much to him as heat units to a mechanical engineer

In this remarkable study of Col J M. Schoonmaker, to whom the amazing success of the Pittsburgh & Lake Erie Railroad is due, Mr Emerson has crystallized his vast experience with humanity, and applied his human standards to a great personality In many ways, the study of Col J M Schoonmaker as a man as a soldier and as an executive, is the most eloquent piece of writing that Mr. Emerson has thus far given to the public, which is saying much when it is remembered that Mr. Emerson has a highly developed literary sense, that he writes with a grace that comes from wide and appreciative reading, and that he drives home an argument with many a striking historical simile In the first half of this book there are more quotable passages than are to be found in a whole volume of most modern essays. This study of Col. J M Schoonmaker as a personality and as an executive might be read with profit by every manager great or small. It is inspiring as well as instructive.

Plant-Life on Land, Considered in Some of Its Biological Aspects. By F. O. Bower, Regius Professor of Botany in the University of Glasgow. Cambridge: The University Press. New York: G. P. Putnam's Sons.

"Few pursuits are more thoroughly misunderstood by the average person of education than that of the present-day botanist . . . Old, time-worn aspects of the science are assumed still to be living problems of the day In no point does this emerge more clearly than in the undue importance attributed to the finding and recording of new species and varieties This is a survival of the time when the science, still in its infancy, was mainly engaged in the recognition and tabulation of living forms" Thus Prof Bower opens his interesting, popularly written book, and prepares the reader for the modern view of botany When the reader who clings to the old-fashioned view has finished this book, he will probably discard the notion that modern botany consists entirely in finding and recording new species and varieties and that a botanist's ability is to be measured by the number of the new determinations He learns that the modern botanist concerns himself not simply with plants as they are, but inquires into their origin, their stability as species, and their relations with one another.

Numbers in History. How the Greeks defeated the Persians, the Romans conquered the World, the Teutons overthrew the Norman Empire, and William the Norman took possession of England. Two lectures delivered before the University of London on October 6th and 7th, 1913, by Dr. Hans Delbrueck, Professor of History of the University of Berlin. London: University of London Press Published for the University of London Press, Ltd, by Hodder & Stoughton, 1913

The critical study of the four great campaigns which form the subjects of those lectures serve to overthrow some deep-rooted ideas The "hosts" of old were anything but hosts as we conceive the term What is more, the great captains of the past seem to have lied about their commands as glibly as tradition itself Instead of overcoming 80,000 Austrians and Sardinians with a handful of 30,000 French, as he claimed, Napoleon was able to oppose 40,000 against 47,000

The mere difficulty of handling large armies—a difficulty which could hardly be overcome before the days of the railroad—speaks eloquently against such vast bodies as the ancients sometimes claim to have hurled against their enemies Even with the aid of nine railways and good roads, Von Moltke found it hard to move 400,000 men. Indeed, at Vionville, he could only use two of his ten army corps Again, the mere task of provisioning an army of 100,000 or 200,000 is in itself something that the ancients could hardly have coped with No wonder that Prof Delbrueck doubts that Attila led 700,000 men from Germany over the Rhine into France, and no wonder that he doubts Herodotus's statement that Xerxes marched westward at the head of 5,100,000, for at that rate, the last man would have just about left Susa when the first arrived before Thermopylæ Dr Delbrueck even goes so far as to maintain that the Persians were outnumbered by the Greeks. "Why should the Greeks have more credibility? Are we to believe them only because we have no Persian author who contradicts their stories?" So, too, he questions whether Charles the Bold was able to oppose 100,000 men against the Swiss, and even goes so far as to maintain that the Burgundians were outnumbered by the Swiss. The invasion of the 200,000 Cimbri of the Roman histories becomes an invasion of no more than 40,000 people, of whom 10,000 were soldiers. Why? Because only that number could have migrated at once across the Alps So the army of William the Conqueror is reduced from 60,000 to 7,000, and that of Harold to 4,000.

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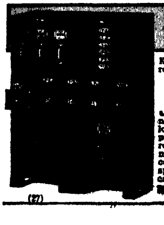

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(27)

Protection from X-rays in Radiography

(Concluded from page 310.)

volume. In certain types of tube, therefore, the platinum anticathode gets red-hot at times, a circumstance which does not cause serious inconvenience with such low current volumes.

When, however, it is desired to employ higher energies in X-ray tubes, this elevation of temperature becomes the source of great annoyance in the operation of the tube and renders its construction very difficult. Here are the reasons: the center of emission of the X-rays is situated in the interior of a closed space in which the most careful vacuum has been made. This reduces very materially thermic radiation, so that, while the output of energy constantly raises the temperature of the anticathode there is but little tendency to heat-loss.

We must also take into consideration the fact that, at the Cochin Hospital, as in nearly all large installations, X-ray tubes are used with a capacity for current equivalent to 4 or 5 electrical horse-power. This energy is almost entirely concentrated in the cathode stream and, consequently, absorbed by the anticathode which reaches a white-hot temperature instantaneously. In order to avoid, as much as possible, this inconvenience, the anticathode is reinforced and constructed of the most refractory metals such as platinum, iridium, and tungsten.

It is also found likewise advantageous, especially when the exposure is to last several seconds, to employ accessory cooling, produced either by a volume of water stored behind the anticathode or by the passage of an air jet of high velocity (Barret-Jaiffe system), which removes with it a great quantity of calories.

Finally, in conjunction with the radiologic installation just described, we find, in this new clinic of the Cochin Hospital, apparatus for the use of high frequency currents,* a remarkably well equipped laboratory in the basement, and a collection of more than 25,000 radiographic negatives of considerable documentary interest.

Vocational Guidance and Efficiency

(Concluded from page 312.)

and economic—of these children; it shows itself also in the lives of the children that it manages to retain, for the majority of these are *not* going to be professional workers, and the school neither prepares them for anything else nor lets them even know that there is anything else. Vocational guidance will necessitate an organization and an administration of schools that will make it possible for the children's native abilities to assert themselves and to record themselves, that they may be utilized in planning each individual's school career in accordance with his particular needs, and not in accordance with a remote and arbitrary standard set up a few generations back by men interested in the evolution of grammatical inflection or Roman table manners.

Modern psychology, resting upon a biological foundation, has shown us the facts of individual variation in a new light. Plato recognized that all men were not equal, and he assigned the various functions in his Republic to classes of people manifesting special traits of character. The assumption of most philosophers who have thought about the distribution of human services in accordance with native talents has been that each person is naturally fitted to some particular place in the social and economic fabric; they have accordingly sought some scheme for discovering the earmarks of the scavenger and of the soldier. The newer studies of human nature show us that there are indeed individuals who are "natural born" poets or painters or hostlers or fishermen; but that the tremendous majority of boys and girls can be roughly divided into a few large groups, and that within each group by far the largest number of individuals are capable of adjusting themselves to a great variety of occupations. We can distinguish roughly between those who have a high degree of mathematical ability, those who have a low degree of it, and those who have a medium capacity for quantitative thinking. But we cannot direct all in the first group into astronomy or molecular physics; nor can we direct all in the last group away from engineering. We may say to a boy who is color-blind that he cannot become a locomotive engineer or a pilot or a sign painter, but color-blindness did not prevent Dalton from becoming a tolerably good chemist.

When it comes to discovering a child endowed with some talents in a high degree, or to encouraging a genius, we do not need "vocational guidance." We need some machinery for discovering mediocre talents in every-day girls and boys, some opportunity for developing these talents, some way of connecting them up with the useful work that is going on around us—that need it is that seeks to express itself through the vocational guidance movement. That the meeting of this need will help industry and commerce should bring the far-sighted business man to the assistance of the movement. That the meeting of this need will help put life and enthusiasm into the schools should bring all educators to its assistance. That the increased efficiency resulting from organized common sense applied to the direction of girls and boys will be both civic and economic, ought to interest the statesman.

Nebuchadnezzar as a Builder

(Concluded from page 314.)

I caused to be more magnificent than before, I did as I was instructed. All my noble deeds for the maintenance of the sacred temples of the great gods, which I did better than the kings, my fathers, I wrote upon a tablet of stone, and fixed for distant days.

"May the wise men after me read of all my works which I have written upon a tablet. May they comprehend the glory of the gods. I accomplished the building of the cities of the gods and goddesses, as Marduk the great lord bade me, and urged my heart to undertake.

"In those days, for Ninharrak, my beloved mistress, who guards my life and gives me good dreams, I dug up and found the ancient foundation of Eharsagil, her temple in Babylon, which fell to ruins in ancient days, and no previous ruler had restored. . . . But the temple was not suitable for the abode of Ninharrak. To strengthen the walls of that temple, and of mortar and bricks to make a temple worthy of Ninharrak, I sought earnestly. Upon the day when I asked the gods to reveal to me the future, Ramman and Shamask decreed that I make three burned bricks of sixteen fingerbreadths in size, and to make an image of burned clay as a charm against disease. And so I made three burned bricks of sixteen fingerbreadths and an image of baked clay to drive away disease, and I placed it in the foundation. With mortar and burned bricks I erected the main temple mountain high.

"O Ninharrak, majestic mistress, when with joy thou enterest Eharsagil, the house of thy pleasure, may words in my favor be ever upon thy lips. Make long my days and establish my years, may long life and an abundance of offspring be decreed by thy lips. Give peace to my soul; make my body strong, and make my visions clear. With Marduk, the lord of heaven, command the destruction of my foes, and the ruin of the land of my enemies.

"In those days, in the temple of Lugal-Marada, my lord, in Marada, whose ancient foundation no former king had seen since the days of old, I sought its ancient foundation and found it, and upon the foundation of Naram-Sin, the king, my ancient ancestor, I fixed its foundation. I made an inscription with my name, and placed it there.

"O Lugal-Marad, lord of all, hero, kindly look with favor upon the work of my hands. Grant as a gift a life of many days, an abundance of posterity, security to the throne, and a long reign. [illegible]

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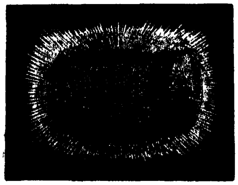

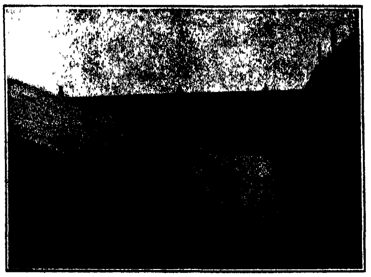

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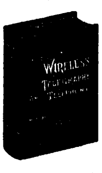

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the evil minded; break their weapons; devastate the lands of my enemies. Slay all of them. May thy fearful weapons which spare not the foe be stretched forth, and be sharp for the defeat of my enemies. May they be at my side. Before Marduk, lord of heaven and earth, make my deeds appear acceptable; intercede for me."

How the Moving Picture Machine Was Made Safe

(Concluded from page 315.)

zine is set in a recess in the main frame of the picture machine. The magazine doors are of full size and hinged to swing open. Spring hinges are used so that the doors will not stand open.

The film is most likely to ignite in the machine mechanism between the upper and lower magazines. There, too, is the projection aperture where the light rays are condensed upon the film. Immediately following the development of the flame-proof film magazine, Mr. Power devised an automatic shutter to cover the aperture and cut off the light when the machine stopped.

The improved form of fire shutter for projection apertures *S* (Fig. 6) is controlled by the speed of the film. It does not open until the film attains a certain speed and closes when the film slows down and before motion actually ceases. The operating mechanism consists of a centrifugal clutch and lifting lever. The clutch revolves when the film moves, and when proper exhibiting speed is attained it operates and moves the lever, which raises the fire shutter, so that the light rays are free to enter the aperture. The shutter is hinged laterally and drops by gravity into a normal closed position.

That portion of the machine-head mechanism of a motion-picture projecting machine which holds the film flat as it is rapidly jerked over the aperture by the intermittent motion is termed a "film trap" or "gate." One of the first things Nicholas Power did was to construct film gates so that films would not burn beyond them when ignited in the aperture. And so snug do these fit that even the sprocket hole margins of films are not burned when films ignite

As the metal surrounding the aperture is heated to a high degree by the condensed light from the lamp and likely to ignite slivers of film which sometimes cling to the parts, Mr. Power set out to minimize the possibility of these slivers igniting and firing the film by arranging a "cooling plate" over the film gate. This plate is set away from the gate about one quarter of an inch and absorbs and radiates the heat from the light On this plate the fire shutter *S* (Fig 6) is mounted.

Having protected the film at the most hazardous point, Mr Power anticipated the necessity for protecting the film above and below the aperture The first step was a flame shield of metal above the aperture to protect the film from fire below The original form has been improved. In recent machines the upper shield *U* (Figs. 6 and 5) is a semi-circular trough of sheet metal, hinged at the bottom, through which the upper loop of film travels.

Next followed a shield below the aperture. This shield was improved from time to time until it formed a complete enclosure about the loop of film below the aperture *L* (Figs. 6 and 5). This form of lower film shield shown in these figures swings open at the side Attached to it is a guard plate *G* (Fig. 5), which arrests the rays of light from the lamp when the shield is thrown open and guards the film from accidental ignition should the operator be careless in handling the films.

Having minimized the possibilities of accidental ignition of the film, Mr. Power turned his attention to improvements in the operating mechanism of the film. One of the most important of these is the automatic loop setter which prevents the loss of the necessary loop in the film between the aperture and the take-up reel. As the film travels past the aperture in rapidly successive jerks a direct pull from the take-up reel would break it. When a film

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breaks this way it continues to feed down from above, and oftentimes ignites in the aperture before the operator can stop the machine. The loss of this lower loop has been a common fault. It is caused in a number of ways—defective sprocket holes in the film, too much tension in the take-up, and the like. But no matter what the cause is, and even when highly mutilated films are run through the machine, the setter automatically adjusts the loop without let or hindrance on the part of the operator, every time it slips. Should the operator desire to set a fresh loop the lever *O* (Figs. 6 and 5) is depressed.

It is not generally understood that each picture on the film must stop over the aperture, but only for a minute fraction of a second. This is the foundation principle of kinematography. The mechanism that controls the stopping and starting of the film, the intermittent movement, must move the film during the period of travel as quickly as possible and allow the longest possible periods of rest, and do this without straining the film. Some years ago Mr. Power realized that the common star-wheel and geneva intermittent movement was not susceptible of further development and forthwith developed the cam and cross intermittent movement. This movement is one of Mr. Power's most signal inventions. It moves the film faster than the star and geneva possibly can, and increases the period of rest. And these operations are accomplished with far less strains and whip-lash pulls so common in the other movements. The film is not jerked from rest and does not attain full speed until the middle of the period of travel. This movement is one of Mr Power's safety features, as it handles weak and poorly patched films without rupturing them, and every film that breaks means a potential fire. Moreover, this movement has eliminated the painful flicker so common in old mechanisms and increased the safety to the eyes of the public.

For these inventions Nicholas Power was awarded a gold medal at the International Exposition of Safety, which was held under the auspices of the American Museum of Safety in New York, December, 1913.

Popular Beliefs and Scientific Facts

POPULAR beliefs on scientific subjects apparently run in waves. Many of our readers remember the interest in hypnotism which followed the publication of "Trilby." Svengali with his "hypnotic eye" at once became a real and possible personage in the public imagination. The newspapers were full of stories of girls and women who had suddenly been fixed and paralyzed by the hypnotic gaze of some mysterious stranger with piercing black eyes, and who had been compelled by his will to fantastic acts which they were powerless to prevent. Fiction writers took up the idea, and stories centering around hypnotic influence became common. It was used as a plea in criminal cases, various culprits alleging that they had been hypnotized and compelled against their will to perform unlawful acts. All this occurred in spite of the fact, frequently stated and known by every scientific man, that the limitations of hypnotism are definite and well recognized, that no person can be hypnotized unknowingly or against his will, and that few persons are so susceptible as to be capable of being compelled to perform acts beyond their own volition and knowledge.

Another popular fiction which later on took the place of hypnotism was that of instantaneous anesthesia. Stories appeared in the newspapers of women who had been accosted by strangers and, under some pretext, had permitted a cloth or a handkerchief to be pressed momentarily over their mouth and nose. Immediate unconsciousness was said to have followed, resulting in a period of insensibility and irresponsibility, varying from a few minutes to hours or even days. Chloroform sprayed into an open window by means of an atomizer, anesthetics tied to a rag on the end of a pole and thrown into a bedroom, instant unconsciousness following the administration of drugs unknown

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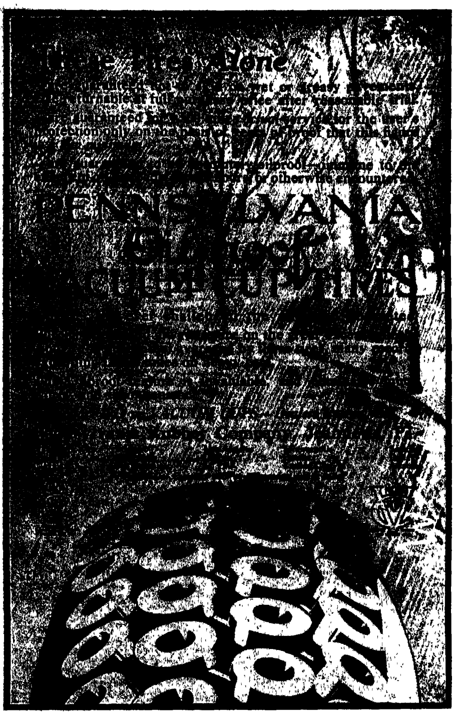

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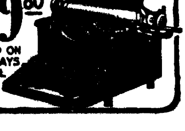

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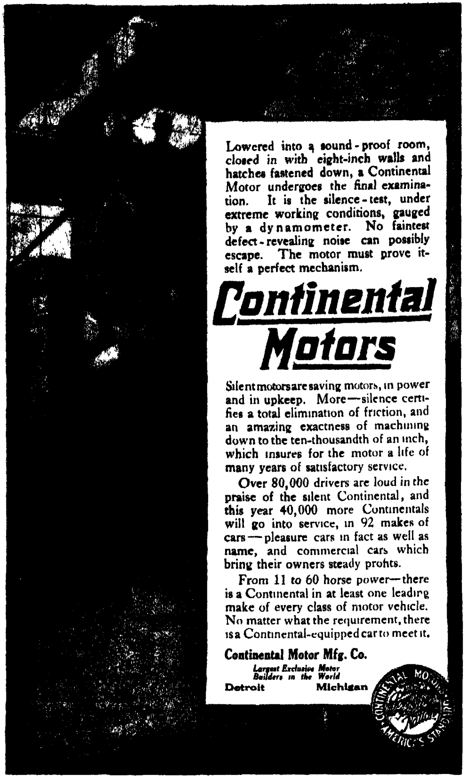

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for nearly all metals, including such difficult ones as cast iron and aluminum, have been the subjects of hundreds of paragraphs in the Scientific American Supplement. We quote a few of the more important articles, as follows:

Scientific American Supplement No. 1673—*Full instruction for Mending or Welding Cast Iron*, gives both brazing solders and fluxes necessary

Scientific American Supplement No. 1713—*Brazing Cast Iron and Other Metals*, gives detailed instructions for the whole operation, and formulas

Scientific American Supplement No. 1644—*Soldering and Soldering Processes*, gives broad general information, and contains in particular a method for pulverizing solders and alloys of great use

Scientific American Supplement No. 1667—*Some Soldering Appliances*, describes the blowpipe and the furnace in their various forms

Scientific American Supplement No. 1481—*Soldering of Metals and Preparation of Solders* gives many formulas for soft and hard solders and fluxes

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to physicians and pharmacists, were some of the variations of this idea. In the minds of physicians and nurses who see every day the administration of anesthetics, such stories only excite mirth. Any one who knows the difficulty and labor of securing unconsciousness through the use of anesthetics, even under the most favorable conditions and with every possible means for restraining and controlling the patient, knows how absurd such stories are—*Journal of the American Medical Association.*

A Rockefeller Fund for the Study of Animal Disease

IT is announced that John D. Rockefeller, through the General Education Board, has added $1,000,000 to the endowment fund of the Rockefeller Institute for Medical Research, for the establishment of a department for the study of animal diseases, and that James J. Hill had given $50,000 to be devoted to the study of the disease known as hog cholera.

The ravages of diseases among animals have not only endangered the health of human beings, but have cost the country many millions of dollars. They are one of the factors in keeping up the "high cost of living."

In the history of medical science the work of Pasteur on anthrax and the more recent observations in this country on Texas fever in cattle, which opened the door to present knowledge concerning insect carriers of malaria, yellow fever and other diseases, are conspicuous illustrations of the value of studies on animal diseases.

How imporant the work promises to be would follow from statistics issued by the Rockefeller Institute It has been estimated that in the Northwest alone hog cholera has killed $60,000,000 worth of swine during the last year.

Significant evidence of the importance of such investigations as the new department will undertake and of the expediency of undertaking them in the manner proposed is to be found in the fact that a contribution of $50,000 to aid in the study of hog cholera has been received from James J Hill

With the present facilities at hand, the income from the $1,000,000 endowment will make it possible to carry on the work on a broad scope at once.

A Legislative Reference Bureau for Congress

THE latest annual report of the Librarian of Congress devotes much space to the proposal embodied in recent bills before Congress to establish a legislative reference bureau, the functions of which would be to collect data bearing on proposed legislation and furnish expert assistance in the drafting of bills The utility of such a bureau, not only as a means of preventing downright blunders in legislation or serious defects and ambiguities in the language of bills, but also of facilitating the work of legislators, is obvious to everybody who has given the matter any attention, and has, moreover, been demonstrated by the experience of about twenty State legislatures which have already adopted a plan of this character. It is proposed to make the Congressional legislative bureau a branch of the Library of Congress.

Herschel Island Police Post Abandoned

IT is reported that this winter, for the first time in many years, the Canadian Northwest mounted police have been obliged to abandon the lonely outpost which the Dominion government maintains, at a cost of over $100,000 a year, on Herschel Island, in the Arctic Ocean, for the purpose of collecting duties from American whalers and prospectors, keeping order among the Eskimos, and assuring Canadian sovereignty in the far North. This action is due to the fact that the steamer bringing supplies from Nome was unable to reach the post on account of storms and ice floes, and may add to the perils of several vessels, including part of Steffinsson's expedition, supposed to be icebound in that vicinity.

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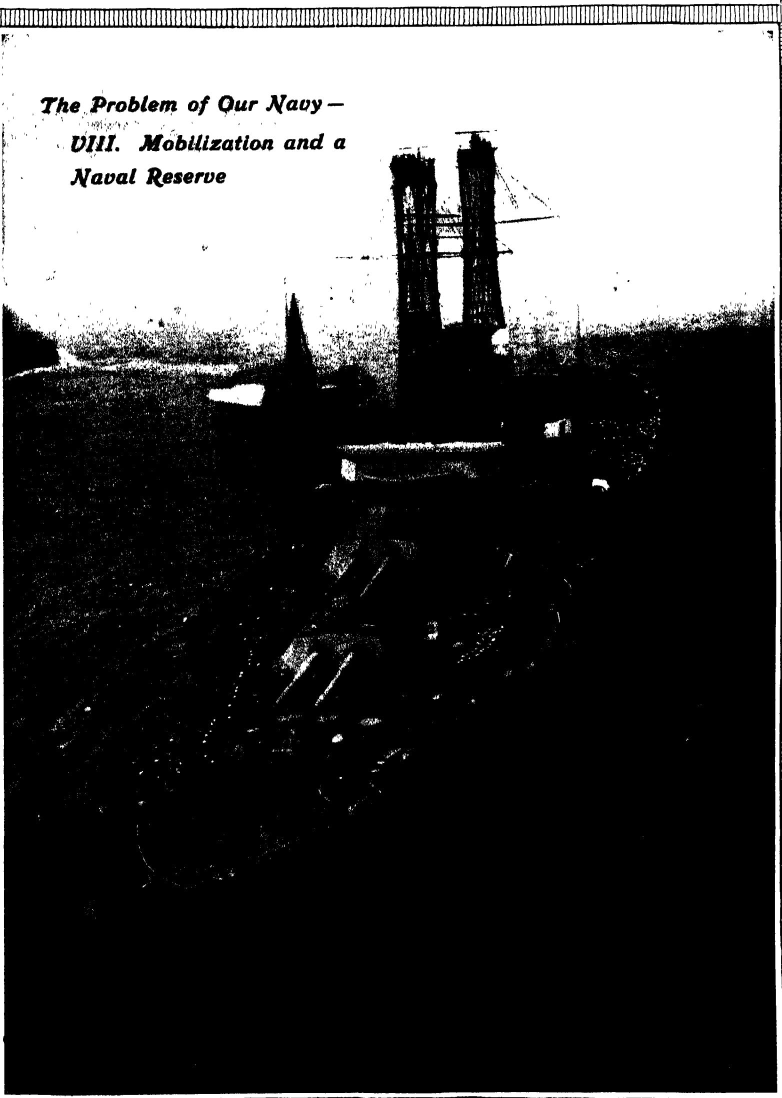

The Problem of Our Navy—
VIII. Mobilization and a
Naval Reserve

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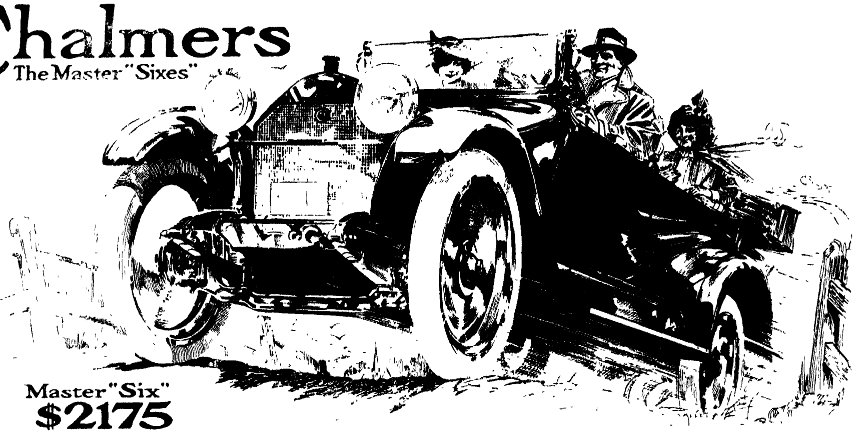

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Do as these men did, talk with those who own Master "Sixes." They will tell you first, that the resistless sweep of the "Six" is not founded upon a fad, but upon these logical reasons silence, smoothness and flexibility. They will tell you that these advantages are so real in the Master "Six" that they are forever spoiled for any other car.

You may still think of a "Six" as necessarily a heavy car, costly to buy and expensive to keep. Once that was true. But that day passed with the coming of the Master "Six."

What Owners Have Found Out

Owners will tell you that it is heavy enough for the utmost in safety and comfort, yet light enough to be easy on tires and frugal with fuel, that the continuous power of its six cylinders has done away with vibration, and so reduces wear and tear almost to nothing.

Former owners of high priced cars have learned that in the Master "Six" they secure the same six-cylinder luxury without the usual six-cylinder expense.

Get the Evidence Yourself

Among the thousands of owners of Master "Sixes," some live in your vicinity. Ask us, or your dealer who these men are. Talk to them. They can give you facts it would be folly to ignore.

Then let our dealer take you on the Chalmers Test Ride. See with your own eyes the beauty of its streamline body. Feel with your own hands the ready response of its supple power. Learn the charm of its luxurious silence and comfort. Then it will be plain why, in half a year, men have paid over ten millions for the Master "Six."

A Master "Light Six"—$1,800

No longer need those who want six-cylinder luxury, hold back on account of the price. Here's the Master "Six" built on a lighter scale; with the same motor but a smaller and lighter model; yet it shows 30 to 50 horse power and has more speed than you'll ever need.

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A Princely Inheritance

This lighter "Six" has all the features which have made the Master "Six" illustrious.

Its small bore and long stroke motor give it the same flexible power—from a snail's pace to an express train speed without shifting gears.

The steady pull of its six cylinders gives smoothness of motion, resistless in its charm; a smoothness that cuts wear and tear to the vanishing point. Its lighter weight means added economy in fuel and tires, while its price makes it easy for multitudes to own "Sixes."

Strength No Longer Means Weight

Time was when "Sixes" were heavy to secure comfort and the required margin of safety. So now one marvels at the sturdy strength of the Master "Light Six."

This is due to the simplicity of the Chalmers design, to heat-treated steel with a four-fold margin of safety, to aluminum castings; to drop forgings. With its deep upholstery and sinewy underslung springs, excessive weight is no longer essential to comfort and safety.

Its light weight and low price mean a double saving. A lower cost means economy once; lower up-keep cost means economy every day.

Built Up to a Standard, Not Down to a Price

The Master "Light Six" is built throughout to meet a standard, not to fit a price.

We use the best steel because we must hold up the strength while we hold down the weight. Valves of ordinary steel are cheaper, but our valves of Tungsten steel never warp nor waste power. Our molded oval fenders cost more than flat ones, but they pay for themselves in added beauty and utility. Every dollar in the price stands for a dollar of real value in the car.

The Price is Lower—Not the Quality

The selling price of the "Light Six" is lower than the Master "Six" because the cost is less. The horse power is less because the motor is lighter, the weight is less because the car is a bit smaller.

But it has the same Chalmers-Entz one-motion starter, the same non-stallable Master Motor. Its roomy body is the true streamline type with flush fitting doors and concealed hinges. Tires are carried at the rear, leaving the running board clear. Its tapering bonnet, underslung springs and oval fenders give it distinction in any company.

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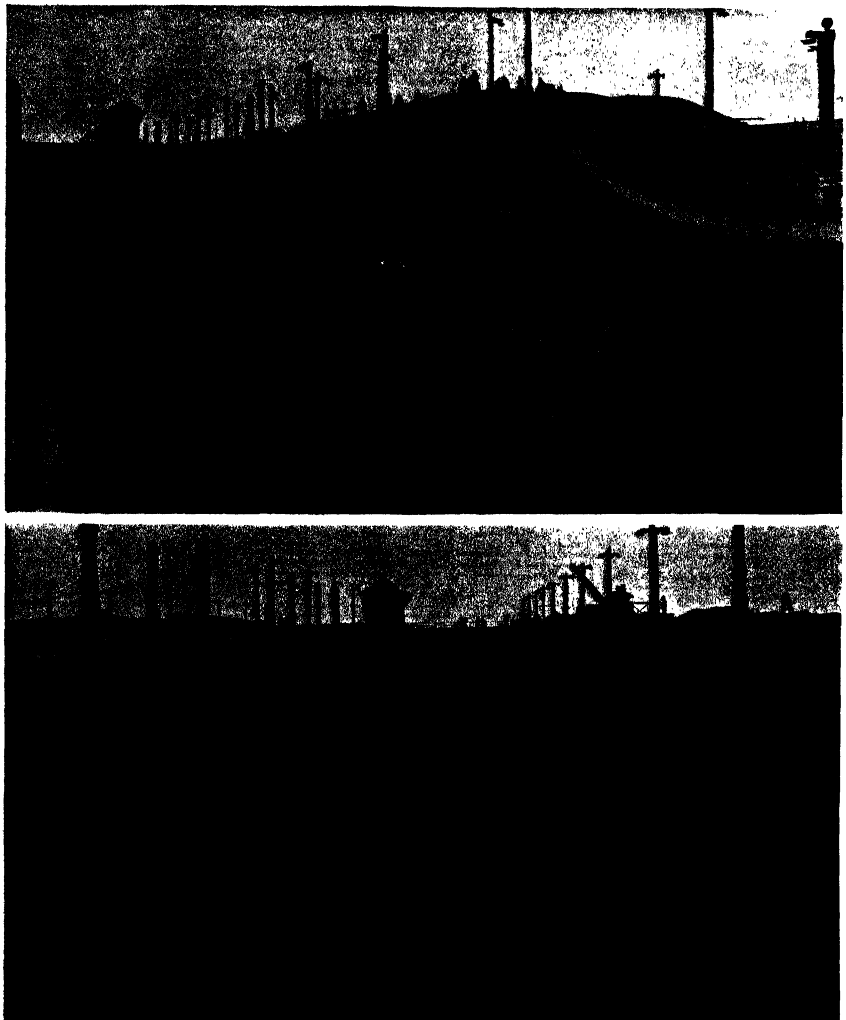

Upper engraving represents submarines entering the lock at Gatun. Lower engraving shows submarines submerged and resting on the cradles.

DRYDOCKING IN PANAMA CANAL LOCKS.—[See page 328.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

A Ridiculous Proposal

THE country has been favored of late with disconcerting evidence of the ignorance of some members of Congress on the subject of our Navy. Lack of elementary knowledge in such high quarters on matters of grave national import is greatly to be regretted; and when to this is added the fact that there occasionally crops out evidence of an active spirit of hostility, the situation becomes deplorable. It was only recently that a certain Senator spoke contemptuously of service in our Navy as being a condition of "paid idleness"—willful misrepresentation which is as unjust to the honorable profession attacked as it is discreditable to its author.

And now comes Senator Weeks with his amazing proposal to place the fast scout cruisers of the Navy in service as carriers of mail and freight between New York, New Orleans, and the Pacific Coast ports of South America! There is no possible excuse for the introduction on the floor of the Senate of such utterly impracticable proposals as this; for it is a fact, which must be well known to every one of the people's representatives in Congress, that there is within a few minutes' reach of the Capitol at all times a body of expert advisers, not merely in the Navy, but in every other Government department, who are not only willing, but very eager to afford all possible technical information and enlightenment on subjects which the members may wish to bring up for discussion, either in the House or the Senate. If Senator Weeks had taken the trouble to submit his proposal to the technical advisers of the Secretary, he would have been instantly assured that to use naval vessels for the transport of mail and freight was *a proposition impossible from every point of view.*

In the first place, the transfer of vessels from naval to commercial service would violate one of the very first principles upon which an efficient navy is maintained, namely, that every ship shall be in such a condition of efficiency that, in the sudden crisis of war, it can instantly proceed to the appointed rendezvous in which the mobilized fleet is being assembled. Of all types of naval ships there is none whose service would be more quickly called for than that of the scouts, whose duties would require them to operate far in the van of the fleet, where they could obtain the earliest possible information as to the strength and destination of the enemy's forces

In these days of watchful preparedness when, as in the case of the German navy, from three fourths to four fifths of the principal units are maintained in full commission and active service, a decisive blow may be struck contemporaneously with the declaration of war, or even in anticipation of it. It has always been a characteristic of our foreign policy, and was never more so than to-day, that we have been reluctant to make any distribution of our military forces which might bear any hostile construction by the nation with whom we were conducting diplomatic exchanges. Our scout service, as we have shown in a recent article, is altogether too limited as it is; and were the only three distinctively scout vessels that we possess to be transferred, as Senator Weeks has suggested, to commercial work, it is perfectly conceivable that a sudden declaration of war might find the "Chester" at Valparaiso the "Salem" at Buenos Ayres, and the "Birmingham" in the Straits of Magellan.

If Senator Weeks had taken the trouble to inquire, he would have been told that one of the chief difficulties of the naval constructor is to find space for such equipment, stores, berthing accommodations, fuel, etc., as must be carried by a warship in the performance of her designated work. He would have learned that every pound of displacement and every cubic foot of space has been allotted, and that it would be impossible, without making serious changes that would destroy the efficiency of the ship, to find space for mail, freight, passengers or any other of the accommodations which are necessary for the service proposed. Furthermore, the motive power of a fast scout cruiser was not designed to give those economical results which are only to be achieved when a designer is left a free hand to design a ship for the particular commercial service for which it is being built.

Let us hope that this latest absurdity will be consigned to the early oblivion which it deserves. We had thought that puerile suggestions such as this belonged to an earlier day, when ignorance about naval matters, particularly on the technical side, was excusable on the ground of unfamiliarity. To-day, when there is so much reliable information published regarding our Navy, there is no possible excuse to be found for such amateur proposals as this.

The "America" Cup Contest

THE present year will go down in the annals of yacht racing as one of the most famous in the history of this noble sport. The coming again to our shores of the indomitable Lipton, this time with the fourth "Shamrock," has resulted in the construction of three defending yachts, one by the veteran Herreshoff, another by his most able American competitor, Gardner, and a third by one of the most promising of our younger designers, Owens.

Particular interest attaches to this year's series of contests, because of the fact that they will be held under a new rule of measurement, which discourages the building of the extreme and almost freakish type of yacht with which the public was made familiar in the last series of "America" cup contests. The old rule encouraged the construction of a yacht of extreme beam, draught, and over-all length, with a flat floor and full ends, and carrying an enormous spread of sail. The new rule governing this year's contests encourages a return to a more wholesome form, with a fuller and deeper body and sharper ends—a type which, after the races are over, is still serviceable for cruising because of its greater head room and its easier motion in a seaway. Furthermore, the more limited draught enables the yacht to enter harbors and cruise in waters which are inaccessible to the older type. When it is remembered that these manifest advantages are secured without any sacrifice of speed, the all-round advantages of the new rule over the old will be manifest.

In Nicholson, one of the younger designers, the challenger has at his disposal the genius of the most successful yacht designer, probably, in Great Britain. "Shamrock IV" will also have the advantage of being absolutely in charge of the most successful amateur yachtsman to be found in the British Isles.

Mental Acrobatics

THAT perfection in the solving of scientific problems is an art to be acquired by training, practice, and experience is so obvious a truth as to require no emphasis and to invite no contradiction.

Not so obvious is the fact that in the selection of problems for inquiry, in the mere asking of questions, much depends on the judgment and common sense of the inquirer. Indeed, it has been said that the great man in science is recognized not so much by the means he employs to attain his ends, as by the purposes toward which he bends his efforts.

The mind of man is so constituted that it must needs ask questions regarding things and events about him. And this is well; for to this inquisitive streak in his make-up we owe probably all the most fundamental discoveries of science; the other impelling agent, the desire to apply natural forces to useful ends, has probably played a less important rôle in the history of science, and has affected chiefly the development of detailed knowledge rather than the discovery of broad fundamental principles.

Now this impelling desire to "ask questions" has its drawbacks. The case is well illustrated in a simile drawn by the great German physicist, Ludwig Boltzmann. He likens the efforts of certain philosophers to those of a baby sucking at a feeding bottle: So long as there is milk in the bottle the baby sucks with gusto and effect; but presently the bottle is empty: still the baby goes on sucking. So, said Boltzmann, certain types of mind are set upon asking questions, and when they have exhausted all sensible questions in their repertoire, they turn to the consideration of vain and futile inquiries. The middle ages were particularly rich in mental gymnasts of this kind, but our day is not by any means free from acrobats who would essay a tight-rope dance across the chasm that separates us from the region—not of the unknown—but of the unknowable.

One of these vexed "problems," [illegible] to have an irresistible fascination [illegible] that of the "ultimate cause" of things.

Now such inquiries as this are a [illegible] for two reasons: first, because they [illegible] to any solution; and, secondly, because we can accomplish all our daily tasks and affairs perfectly well without waiting for such a solution. In other words, the inquiry is both fruitless in its results and useless in its applications.

If evidence is needed to substantiate these statements, let the reader reflect over this: If the search after causes were really so vital a function of scientific research, surely we should expect to find the word "cause" to recur somewhat frequently in works presenting the results of the most advanced phases of modern science. As a matter of fact, advanced sciences, like gravitational astronomy, even physics in general, never employ the term "cause." Indeed, the word could well be spared from the scientific vocabulary. "The word 'cause,'" says Bertram Russell in the *Proceedings of the Aristotelian Society*, "is so inextricably bound up with misleading associations as to make its complete extrusion from the philosophical vocabulary desirable. . . . The reason why physics has ceased to look for causes is that, in fact, there are no such things. The law of causality, I believe, like much that passes muster among philosophers, is a relic of a bygone age, surviving, like the monarchy, only because it is erroneously supposed to do no harm."

The fact is, the physicist has not only learnt to answer questions, but to ask them. He spends no futile efforts seeking to find the ultimate cause of an event; but instead, he studies the various *determining factors* which influence a given phenomenon. He measures each factor and the phenomenon studied, and seeks to find an equation or formula by which the one can be calculated when the others are given. In technical language, he seeks to discover the *functional relations* between the variables which appear in his problem. Once this is done, once his formula is found and proved correct by actual test, his task is finished, and any further inquiry after the "cause" of things seems a fit subject for an inmate of an institution very different in character from the physical laboratory.

Industrial Research and the Steel Rail

IN the course of his presidential address before the American Chemical Society, Arthur T. Little, speaking on the question of industrial research in America, showed how the steel industry in its many ramifications promotes an immense amount of research, which ranges from the most refined studies in metallography to experimentations upon the gigantic scale which was required for the development of the Gayley dry blast, the Whiting process for slag cement, or the South Chicago electric furnace. This last is the furnace which has formed the subject of considerable illustration and description in the SCIENTIFIC AMERICAN during the past two years. The president of the American Chemical Society is of the opinion that this furnace has probably operated upon a greater variety of products than any other electric furnace in the world; and he draws attention to the fact that up to the autumn of last year, after two and one half years of operation, no reports of breakages had been received from the 5,000 tons of standard rails made from steel produced in this furnace. That would be a significant statement under any conditions, and it is particularly so when it is borne in mind that, during the past thirty years, the average total weight on the drivers has increased over two hundred and fifty per cent. Thus, in 1885, the average total weight on drivers was 60,000 pounds; in 1907 it had risen to over 180,000 pounds, and in that same year it reached a maximum in a few locomotives of 316,000 pounds. Yet, in spite of this enormous increase in the concentrated load, the weight of rails during that same period had increased only from between sixty-five and seventy-five pounds to between eighty-five and one hundred pounds per yard. In the years preceding the introduction of the electric furnace and the manufacture of steel rails from its output, the breakages were so frequent that they constituted one of the most serious perils, if not the most serious, of railroad travel. Thus, in 1905 conditions were so bad that out of a lot of 10,000 tons, no less than twenty-two per cent were removed during their first year of service because of depression in the head of the rails.

As promoting the safety of railroad travel, the product of the electric furnace may well take rank with the Westinghouse brake, block signaling, automatic stops, and the steel car.

The Exploration of Albania is perhaps the most urgent problem in European geography. A society has been formed in Vienna to promote the investigation of this terra incognita, and one of its members, [illegible] of Graz, is about to undertake a preliminary [illegible] survey of the country, which [illegible] a year.

Electricity

Railroad Wires Underground.—As a result of the recent storms which crippled service between New York and Philadelphia by blowing down telegraph and telephone poles along the tracks, the Pennsylvania Railroad has decided to run its telegraph, telephone and signal wires in conduits underground.

High-Power Transmission.—At present there exists in Europe only one line carrying power at a tension superior to 100,000 volts; this is the 60 kilometer line at 110,000 volts equipped in Silesia by the "Lauchhammer Aktiengesellschaft." In the United States, on the contrary, distributions at high tensions have rapidly developed. There are more than fifteen transmitting current at a pressure higher than 100,000 volts, and over distances greater than 500 miles.

Electric Dock Equipment.—Quite an extensive electric outfit is used at the new docks on the Spree, at Berlin. The docks are well laid out for handling grain, as well as for receiving supplies of benzine in underground tanks, coal, brick and other freight, and the port is connected by tracks with the railroad. No less than 37 electric motors are used for the ten main cranes, while 28 motors serve for various conveyers for the grain docks. Numerous other cranes besides winches and elevators take upward of 20 motors. The whole is a model plant. Some 200 railroad cars are accommodated in the dock quarters, and most of the material is handled by electric devices so as to assure a rapid service.

Alternating Arc in Mercury Vapor.—It has commonly been supposed that it is impossible to maintain an alternating arc in mercury vapor, for low frequencies and moderate voltages. In a paper read at the Paris Academy of Sciences, it was shown that this can be done. The quartz tube is full of mercury and ends in two reservoirs in communication with the atmosphere. Placed in series is a self-induction enabling the short circuit current to be reduced to about 2½ amperes. The arc is started by breaking the column in the middle by causing the mercury to bubble. A true alternating arc is established, the two alternations being separated by a period of extinction of about one thousandth of a second.

German Army Searchlight.—The German army is making use of a type of field electric searchlight which can be raised to quite a distance above the ground by the use of a telescopic tubular pole, this being made in four sections. By means of a hand winch, the tube is extended to the desired height, so that the beam can be directed to advantage. The apparatus is mounted on a two-wheel truck which is coupled to a second truck with driver's seat so as to make a four-wheel wagon. On the ground, the searchlight truck is uncoupled, and set at the proper point. The mast portion is folded down flat against the framework when not in use. Current comes from a dynamo group on a special wagon.

Effect of the Eclipse on Radio-telegraphy.—The British Association for the Advancement of Science has issued a bulletin calling attention to the exceptional opportunities that will be afforded by the total eclipse of the sun on August 21st for studying the effect of light and darkness upon radiotelegraphy. The eclipse will be total along a strip extending from Greenland across Norway, Sweden, Russia and Persia to the mouths of the Indus. In Russia, the duration of totality will be a little more than two minutes. There are two main points calling for investigation during the eclipse. In the first place, the propagation of signal-bearing waves through air in the umbra and penumbra will probably obey laws different as regards absorption and refraction from those obeyed in illuminated air. In the second place, the strength, frequency and character of natural electric waves, and of atmospheric discharges, may vary. To investigate the propagation of signals across the umbra, it will be necessary to arrange for wireless telegraph stations on either side of the central line of the eclipse to transmit signals at intervals while the umbra passes between them. It is thus very desirable that the Scandinavian and Russian stations should transmit frequently throughout several minutes before, during, and after totality. But stations other than those favored by their proximity to the central line should endeavor to keep a complete record of the variations of signals during the eclipse. Stations in Europe west of the central line, and stations in the Mediterranean and in Asia Minor, may find noticeable changes in the strength of signals, particularly long distance signals, between the hours of 10 A. M. and 2 P. M., Greenwich time; and it is probable that the stations of India and East Africa, and ships in the Indian Ocean, may feel the effect of the penumbra in the afternoon. On the other hand, ships in the Atlantic, and fixed stations in Eastern Canada and the United States, will probably be affected by the penumbra in the early morning. At Montreal, the eclipse (partial) is at its greatest phase at 5:32 A. M. Standard Time. It is requested that those possessing the necessary facilities and willing to make observations during the eclipse, communicate with the Hon. Secretary, Dr. W. Eccles, University College, London, W. C., at the earliest possible date.

Science

An Exhibit of Rain-gages.—The British Rainfall Organization is arranging an exhibit in the science section of the forthcoming Anglo-American Exposition, one feature of which will be a collection of rain-gages, of the 1814 period and earlier, which will be placed side by side with the gages used at the present day.

Theodore Roosevelt and the American Museum of Natural History.—It is announced that Theodore Roosevelt will give to the American Museum of Natural History $2,000 when he returns to New York, and that he will assist it in raising $4,000 more to carry out explorations in South America which are to complete the work which he has begun.

Vaporized Tar as a Fuel.—The Indiana Steel Company, at Gary, is using coal tar as a fuel for some of its open-hearth furnaces. The tar is heated till quite fluid, and injected under the boilers with a blast of steam which, of course, atomizes the tar. It burns much like a jet of oil and steam, and is economical, since the Gary plant secures much tar from its by-product coke ovens.

Expedition Shipwrecked on Hudson Bay.—The Norwegian ethnologist Chr. Leden, who was commissioned by the Canadian government to make a study of the Eskimos in northern Canada, and was also making collections for Canadian, German and Norwegian museums, was recently shipwrecked on Hudson Bay, and lost his whole outfit. After suffering great privations, he reached Fort Churchill early in February.

Hardening Steel with Compressed Air.—The usual methods of hardening steel in oil, water and other special baths produce a great tension along the line of contact between the hardened and unhardened parts. A recent German improvement on this process is the use of a number of jets of compressed air playing on the hot steel. The zones of cooling are graduated beautifully by varying the number and spacing of the openings in the nozzle. A wide range of results is possible by adapting the shape of the nozzle to that of the work.

Pharaoh's Serpents.—A cone of mercuric sulphocyanate, when ignited, burns with the development of a tremendous amount of ash. The cone seems to swell and writhe away like a serpent, hence the name. Any boy can make the cones at little expense. To a solution of corrosive sublimate, add a few drops of ferric chloride. Dissolve potassium sulphocyanate in water, and slowly add this to the other solution, until, after stirring, a red color remains. Filter through a sheet of muslin and form the white curds into little balls or cones. Dry, and you need only touch a match to produce Pharaoh's serpents. Do not breathe the vapors.

Treating Yeast with Ozone.—A curious commercial application of ozone has just been developed in the brewing industry. Samples of brewers' yeast treated with ozone for five minutes show greater fermenting power than untreated yeast. During the first day or two, there is no gain, but after that ozonized yeast exhibits fermentative power markedly in excess of untreated yeast. The benefit comes from the inhibitive action of ozone on objectionable organisms, and also because the weaker yeast cells are eliminated and the stronger ones stimulated in fermentative power. In the brewing industry, the over-production of yeast cells is a great source of loss which will doubtless be lessened by ozonization.

The Lost Russian Arctic Expeditions.—The Russian government has at last decided to make a search for the missing expeditions of Sedov, Russanov, and Brussilov, and has bought two Norwegian vessels, the "Hertha" and the "Eclipse," for this purpose. The "Hertha," with a Russian crew, will go in quest of Capt. Sedov's expedition, which is supposed to have sailed last August from the north coast of Nova Zembla for Franz Josef Land, and has not since been heard from. The "Eclipse," with a Norwegian crew, and under the command of the veteran explorer Capt. Otto Sverdrup, will proceed to the Kara Sea in hope of locating the expeditions of Brussilov and Russanov, both of which have been missing since the autumn of 1912. The former set out to attempt the Northeast Passage, while the latter was last heard from when *en route* from Spitsbergen to Nova Zembla. The rescue ships are to sail from Christiania, June 24th.

Capt. Amundsen's North Polar Expedition, which, as originally planned, was to have sailed in the summer of 1913, and was postponed for a year in order to give the scientific staff more time for preliminary studies and training, has now again been postponed for a year; this time because it appears that the "Fram," the vessel in which the expedition is to sail, cannot reach San Francisco in time for an early start from that port. Last year, the little vessel sailed from Buenos Ayres to Colon, in the expectation of proceeding thence via the Panama Canal; on account of the delay in the opening of the latter, this route was finally abandoned, and the "Fram" started on the long journey around the continent in which she is now engaged. The further postponement of the expedition will be turned to advantage, especially in giving the explorers time to become expert in the use of aeroplanes, three of which are to be included in the equipment of the expedition.

Astronomy

The Duration of the Sun.—Adopting the well-known hypothesis of Helmholtz, which attributes the production of the heat emitted by the sun to its contraction, an idea can be formed of the sun's duration. If one gives to the sun a coefficient of expansion intermediate between that of mercury and that of gas, one arrives at the conclusion that it has taken one to three millions of years for the sun to contract to its present radius, in particular, it would have taken 10,000 years to contract from infinity to a radius twice its present radius. Finally, the sun will take 200 millions of years to contract from its present radius to half that radius, and even then its temperature at the surface will be 3,000 degrees.

Earth-Shine on the Moon.—When the sun has disappeared beneath the horizon and we no longer receive its rays direct, it also happens that its light continues to reach us, indirectly and feebly, reflected by the whole or part of the disk of the moon. Inversely, when a portion of the lunar disk is not illuminated directly by the sun, it happens that it is feebly illuminated by the earth-shine; that is to say, by the reflection that those portions of the terrestrial surface which are at that moment exposed to the sun. Mr. F. W. Very has endeavored to determine the brightness of the light received in this way by the moon and has measured the intensity of this light compared with the intensity of those parts of the lunar disk which are illuminated directly by the sun. The result is that the earth-shine on the moon is about 1,600 times feebler than the mean brightness of those portions illuminated by the sun a little before the first quarter.

Distance of the New Star in Gemini.—In the spring of 1912, considerable interest was excited by the sudden appearance of a brilliant star which became visible to the naked eye during some weeks in March and April. After May it was no longer visible except in powerful telescopes. Mr. Slocum has attempted to measure the parallax of this star, and hence to deduce its distance from us. Parallax is a measure of the change of perspective a moving object presents when regarded from two different positions Advantage is taken of the revolution of the earth in its orbit, and measurements are made at intervals of six months Mr. Slocum, with the great 40-inch refractor at the Yerkes Observatory, has taken fifteen photographs of the new star at three different periods of six months. Six comparison stars were selected as near the Nova as possible, and distributed approximately symmetrically round it. A discussion of the results shows that the Nova is about 296 light years away, so that the sudden blaze of 1912 corresponded to some catastrophe which occurred in the beginning of the seventeenth century

Double Stars in a Double Star System.—The two stars Mizar and Alcor form a double star system which can easily be perceived by the naked eye This was not the case formerly, as the Arabs used the resolution of the system into its two components as a test for good eyes It would seem, therefore, that this star has increased in brightness since the tenth century, a supposition which is supported by the fact that it is not mentioned by the ancients. The history of this star was familiar to astronomers when it was found, in 1907, that Alcor is itself a double star. It is now discovered, by Mr. Harlow Shapley, that Alcor varies in brightness, the variations having a feeble amplitude and a short period. The spectrum type of Alcor, which is a star A5, that is to say a white star with hydrogen predominating, and the doubling of the lines, announces a variation of the Algol type, i. e., by eclipse, rather than continuous variation It is supposed that there exists a couple of elliptic stars very close together and inclined on their orbit in such a way that the mutual eclipse is feeble or almost nothing, the variations of brightness resulting from their marked ellipticity.

The Stellar Magnitude of the Sun.—The classification of the stars into orders of magnitude depending on their apparent brightness was undertaken a little hastily, with the result that many stars have been found which are brighter than stars of the first magnitude. Aldebaran is a typical star of the first magnitude, but Sirius is much brighter. Consequently the system of classification has had to be extended. A star of the first magnitude is 2.5 times as bright as a star of the second magnitude; a star of the second magnitude is 2.5 times as bright as a star of the third magnitude and so on. Stars which are 2.5 times as bright as a star of the first magnitude are called stars of 0 magnitude, while stars 2.5 times brighter still are said to be of the —1 magnitude and so on. Prof. Ceraski has made measurements to determine the magnitude of the sun, reckoned in this way. By adopting different methods of measurements, he reaches very accordant results, and it appears that our sun is a star of the —26.5 order of magnitude, which means that it sends us as much light as 880 millions of stars of the first magnitude. At the distance of a little over four light years, i. e., about 29,000 times its present distance, it would be a star of the first magnitude, so that, considered as a star, it is nothing out of the ordinary.

Moving Pictures Without a Screen

A Remarkable Development in Kinematography

By the English Correspondent of the SCIENTIFIC AMERICAN

SOME five years ago a German experimenter, Herr Messter, as a result of some particular investigations, discovered that if moving pictures were projected by reflection in a certain manner, the stage could be set with scenery and properties, as for a regular play, with the result that the usual white screen could be eliminated, and that the photographic figures could be moved about within a certain area in such a manner as to convey the illusion that living performers were seen instead of photographic reproductions. He pursued his experiments, but was faced with the initial difficulty that only small figures could be projected, and this fact tended to destroy the illusion, since to maintain the latter, life-size portrayal of the performers was imperative. Another complexity which troubled him was the destruction of the coloring qualities owing to the high light necessary. This latter problem was overcome by utilising pierrots and clowns, in which only black and white dress and make-up were required. Such a limitation was a handicap, but, nevertheless, when such pictures were shown, considerable interest and wonder as to how the effects were obtained, were aroused. The fact that the figures were dwarfish, and yet apparently endowed with life, enhanced the mysterious effect. By patient experimenting the inventor at last overcame the latter deficiency, and having succeeded in getting his figures life size, public exhibitions of "Alabaster," as it was called, were given in Vienna with great success. The absence of the familiar white screen proved an irresistible attraction. At the Scala Theater in London the pictures, upon their presentation, proved an instantaneous success.

The explanation of the mystery is exceedingly simple. Kinoplastikon is no more nor less than a revival of the famous "Pepper's Ghost" idea, adapted to the kinematograph. Singing and talking effects are obtained by electrically synchronizing a talking machine with the acting.

The accompanying diagram explains exactly how the stage is set out. Some years ago a British kinematograph experimenter ascertained that, if moving pictures are thrown through a translucent screen to be projected finally upon a plate-glass mirror, the pictures stood out with greater definition, softness and plasticity. In this instance a screen formed of a kind of ground glass was placed in front of the projector lens. This is the basis of kinoplastikon.

The projector, instead of being set at right angles to the screen, as is usually the procedure, either in front or behind, is placed in the wings, as shown in the diagram. The picture thrown from the projector strikes the translucent screen *A* and passes through it. Instead of falling finally upon a white sheet it strikes a sheet of plate glass *B*, which is set at an angle of 45 degrees to the proscenium opening, and consequently to the audience seated in the theater. This plate-glass screen virtually occupies the whole of the stage, terminating at either end in side wings, while other wing settings may be introduced as desired In reality the plate-glass screen *B* acts merely as a reflecting medium to the translucent screen *A* At the rear of the stage, parallel with the proscenium opening, and consequently also at an angle of 45 degrees to the plate-glass screen *B*, is the rear back-cloth which is of sufficient dimensions to cover the whole of the proscenium opening, as in an ordinary stage setting. At a short distance from the back-cloth special side wings *E* are set, the opening left being coincident with the area occupied upon the plate-glass screen *B* by the image of the film. From *E* to the back-cloth *F* the stage slopes upward at 1 in 20, and constitutes a supplementary floor. When the figures are projected they appear to walk upon this latter at the point indicated by the dotted line *C*.

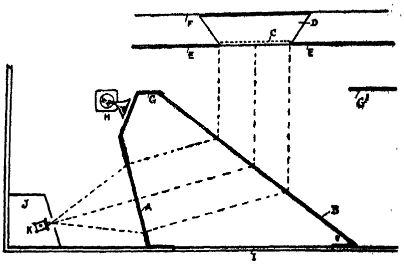
When the pictures are projected they pass from the projector *K* through the translucent screen *A*, and are seen upon plate-glass screen *B*. Here they are bent and apparently, from the audience's point of view, they appear at *C*, although as a matter of fact, it is merely the reflected images upon *B* which are seen. The latter being transparent the pictures appear to stand before the back-cloth *F*, and to all intents and purposes are alive and real players, because when walking off the stage they appear to pass behind the side wings *E* in the true legitimate manner.

The preparation of the pictures is carried out upon special lines. The studio has a back-cloth of black velvet forming a neutral background, while the figures for the most part are clothed in white, although this latter attribute is not essential in the latest development of the idea. But, as the background is a solid black, the images upon the film stand out against a transparent ground which in projection enables the figures to be *en silhouette* against the back-cloth of the stage setting. The density of the figures upon the film is sufficient to prevent the background from showing through the pictures seen by reflection, so that an apparent ghostly effect is neutralized. The figures in the film stand and move upon a vignetted base corresponding to the floor, and as this blends with the supplementary stage floor *D*, the figures, when projected, appear to stand upon the actual stage. The gramophone is set at *H*, which is as near to the actual apparent position of the players upon the stage as possible without suffering any depreciation in the volume of sound emitted. Were it set behind the side wings *E*, and level with the apparent position of the performers, the sounds would be muffled.

The talking machine and photographic records are not produced simultaneously, as with the Edison kinetophone and the Gaumont chronophone. The gramophone record is made first. Then the artists proceed to the theater, and act the play, repeating the words synchronously with the accompaniment of the previously prepared record. The gramophone is introduced to secure synchrony between lip movement, action, and sound. The operation is one of some delicacy, depending upon careful rehearsal and timing.

The talking machine system adopted is that known as the "vivaphone," which has proved remarkably successful. In the reproduction, striking coincidence between the action and lip movements of the artists and the talking machine is secured by means of a simple and effective electrical apparatus. In the projecting box is an illuminated indicator having an oscillating hand. The central position corresponds with dead synchrony between sound and movement. As the electrical apparatus of the gramophone is connected with the projector, the operator strives to keep this moving hand in the central position. On one side of the "synchrony" mark is a red light corresponding to "too slow," i. e., the pictures are in advance of the sound; while on the opposite side is a green light indicating action being behind the sound. If the former happens the operator decreases the handle turning speed, while in the latter instance the projector is accelerated. The indicator being in the projecting box, immediately before the operator, the latter has no need to watch the screen to see if he is keeping step. He merely follows the indicator. As in the majority of cases the projector is operated by electricity, the task of maintaining synchrony is exceedingly simple. This method of reproducing sound and movement simultaneously has proved the simplest, most effective, and most economical yet devised. After the gramophone record has been obtained, and should anything go wrong with the acting of the scene, or revisions appear essential, the wastage concerns the film only, whereas if the two different records are produced simultaneously, as in the Edison and Gaumont methods, a mishap, either in recording sound or movement, affects both issues, with the result that both have to be done again.

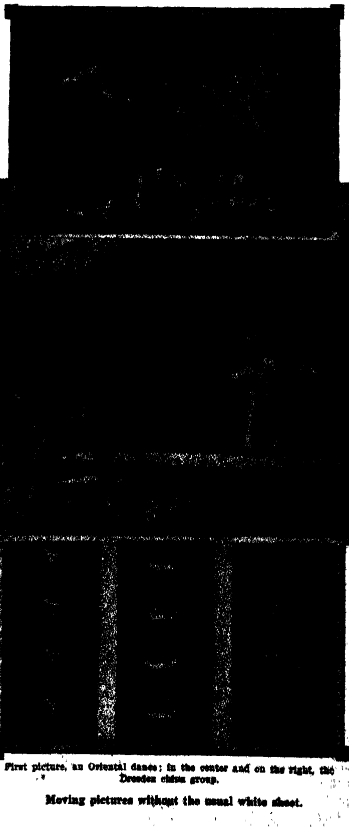
One very noticeable effect of this method of projection is the absence of flicker. The translucent screen appears to absorb all defects.



I, proscenium opening from the auditorium; *K*, the projecting machine in the fireproof box *J*, *A*, translucent screen set on left-hand side of stage, upon which picture is projected; *B*, plate-glass screen set at angle of 45 degrees to proscenium opening, bisecting clear part of stage, the inner end terminating in scenic wing piece *G*, *G*², opposite wing piece; *F*, back-cloth parallel with proscenium opening; *EE*, scenic wing pieces set to provide opening size of the image thrown upon plate-glass screen *B*, represented by the dotted lines from the bioscope From *E* to *F* the stage slopes upward at 1 in 20 to form a supplementary stage floor. When the pictures are projected *en silhouette*, as described, upon screen *B*, the feet of the figures appear to be on the stage floor at dotted line *C*.

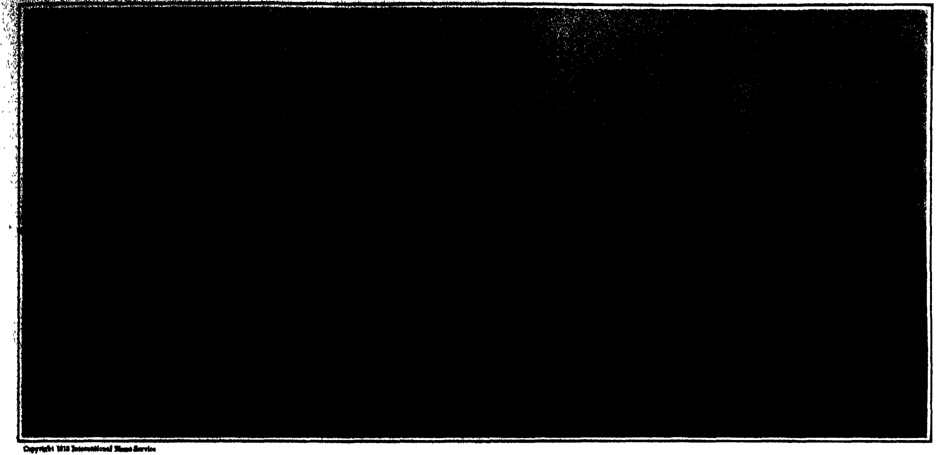
Setting the stage for "kinoplastikon."

A representation of a Dresden china comedy.



First picture, an Oriental dance; in the center and on the right, the Dresden china group.

Moving pictures without the usual white sheet.



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MODERN wars begin with all the surprise and violent shock of an explosion of dynamite—as witness the night attack by the Japanese destroyers at Port Arthur, which, even before the declaration of war, placed the Russian Pacific fleet out of commission and gave to Japan the command of the sea.

The striking of the first telling blow and the ability to follow it up are possible only when the belligerent, having set in motion a carefully prepared plan of mobilization, is able swiftly to concentrate the whole of his naval and military forces in the theater of war—as witness the fact that following immediately upon the Port Arthur attack, Japan transported to the mainland an army of 100,000 men in four days time.

Had Japan followed our own policy of unpreparedness, had she possessed no plan of mobilization, that is to say, had she left the work of organizing an auxiliary fleet to be done after war was actually upon her, as we did in the Spanish war, months of valuable time would have been lost, Russia would have been able to concentrate an overwhelming army in Korea and Manchuria, and the defeat of Japan would have been inevitable.

Mobilization is defined in the Dictionnaire Militaire as "the passage from a peace to a war footing, the period during which a 'navy' should be provided with everything which is necessary for it to go into a campaign and at once begin active operations."

The same authority goes on to say: "It is naturally important that this period should be as short as possible, for upon its efficient and complete achievement often depends the fate of the first encounters. Therefore, each nation has spared no pains to foresee in all their details the complex operations necessary to be carried out during this period of transition, so that when the time arrives, they may be executed without disorder, omissions or loss of time."

Have we any such elaborate system of mobilization?

The last attempted mobilization occurred in the North River, New York, in October, 1911, when there were assembled no less than 127 ships, including 31 battleships—an imposing array of naval *materiel*, which, if the individual ships had been fully manned and provisioned, and replete with full supplies of coal and ammunition, and if the fleet as a whole had included all the auxiliaries necessary to enable it to keep the sea, would have been a most formidable fighting force.

But what were the facts?

1. The ships in full commission were more or less depleted, both of officers and men, in order to furnish trained men to assist in handling the ships that were temporarily commissioned for the review.

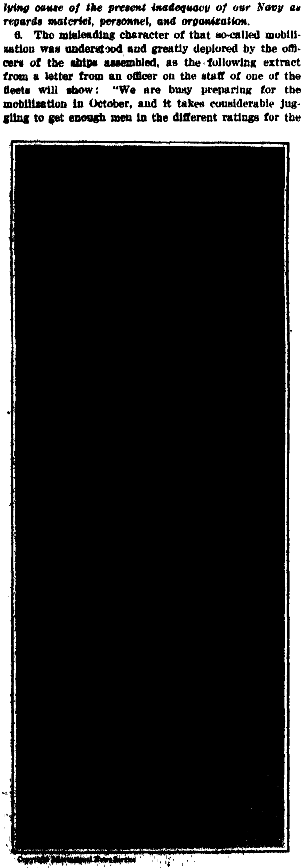
2. The ships sent to the review from the reserve were temporarily commissioned with skeleton crews, sufficient only for purposes of navigation.

3. The fleet included ships that were under repair, and new ships that were completing at a navy yard, which were towed by tugs to the North River and anchored there.

4. The greatly misleading impression of naval preparedness afforded by this so-called mobilization was not chargeable to an absolute lack of preparation; for the work of getting up this show of October was begun in the preceding July and August.

5. *The responsibility for this farce was not chargeable to the officers of the Navy. It was a political move, both in its conception and in its intended effect, and as such, it points with an unerring finger to the underlying cause of the present inadequacy of our Navy as regards materiel, personnel, and organization.*

6. The misleading character of that so-called mobilization was understood and greatly deplored by the officers of the ships assembled, as the following extract from a letter from an officer on the staff of one of the fleets will show: "We are busy preparing for the mobilization in October, and it takes considerable juggling to get enough men in the different ratings for the various ships. In fact, it looks as if we might have to leave one or two behind. We haven't yet managed to straighten matters out, though I dare say we will be able to pull through somehow. But the ships will have very slender crews—not enough to clean them; just enough to take them there and back."



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Rear-Admiral Badger, Commander-in-Chief of the Atlantic Fleet.

Such was our mobilization only so recently as 1911.

But how is it with the other naval powers? We have noted above the efficiency of the Japanese mobilization; now let us consider briefly two other countries which are fully alive to the necessity of a plan of mobilization that is capable of swift execution—England and Germany.

As regards the British fleet the procedure is as follows: From the Admiralty, London, a single telegram, consisting of the single word "Mobilize," is sent to each of four leading naval ports. This sets in motion the entire machinery of mobilization in all its details. These details are specified in complete mobilization plans, and in orders that define the duties of everyone concerned, whether with the military ships, auxiliaries, transports, colliers, supply ships, ammunition ships, etc. *So perfect is the mobilization system that all the fighting ships of the British Navy can be sent, in twenty-four hours time and without any previous notice, to the mobilization rendezvous, manned with regularly enlisted trained men, and fully provisioned and equipped*

There is no question as to the thoroughness of the German mobilization plans; for it is known that *the German torpedo flotilla can put to sea in two hours, fully prepared for war; the regularly commissioned battleships and cruisers in six hours; and the reserve ships not very long afterward.* No officer or enlisted man of the ships in commission is beyond the reach of recall within the time limit.

Mobilization, to become efficient, presupposes certain concomitant conditions, in all of which we are deficient, and in many of them unbelievably so. Chief among these are the following·

I. *War Plans.* Less than eighteen months ago, one of the most able and progressive officers of our Navy said: "When war becomes imminent, the question which must necessarily suggest itself is: 'What shall we have to do? What is the general plan of operations?' This must be the basis of mobilization and of all other preparations for war. It is a grave statement to make, but it is a fact that war in the immediate future would find us without a single adequate plan of campaign against any first-class power"

II. *Personnel.* A personnel sufficient in numbers to man the reserve ships and the auxiliaries, hastily recruited, but largely untrained, would render defeat probable. We have made no provision, adequate either in numbers or efficiency, for manning even the few fighting ships in reserve, not to mention the auxiliaries. Such increase as we might make would be mustered too late to be of use in the opening critical stages of the war against a well prepared enemy.

We deal with this subject in detail later in this article.

III. *Ammunition, Supplies, and Provisions* In a previous article we have shown how deplorably deficient we are in torpedoes and mines, having only about one round of torpedoes per tube and an even greater deficiency in mines and mining outfits. To realize the full efficiency of a mobilization there should be on hand a large reserve of supplies and provisions, coal, etc., and full provision for maintaining the supply either from Government or private sources, as the war proceeded.

Auxiliary Ships. Absolutely fundamental to any successful mobilization, is the listing of and provision for equipping the vast fleet of auxiliary ships, drawn from the merchant marine, which would be required to render the operations of the fighting fleet effective.

Foreign maritime nations list and inspect their merchant ships, assign their service in case of war, list the personnel and maintain the lists corrected to date, contract with the owners for chartering the ships, and in time of peace prepare the plans and material for their quick conversion for war purposes.

We are only now beginning to do this enormous work. It should be prosecuted with all dispatch, and Congress, so far as it lies in its power, should render every legislative aid and encouragement that it can.

Did we find ourselves suddenly at war with Japan, it would require two infantry divisions, totaling 40,000 men and 17,000 animals, to hold our possessions in the Pacific. This would call for over 100 vessels of nearly 350,000 gross tons for transport. Not one half of that number of vessels are available to-day in the Pacific that are suitable as transports. Our transport service would furnish only 50,000 tons. This would be the condition as regards the army; and the auxiliaries for army transport would have to be found after the naval auxiliaries, which in the nature of things would have the first call, had been taken up.

And this suggests the pressing need (for adequate naval warfare) of a large merchant marine.

But that is another story.

Naval Stations and Bases. The prompt equipment and supply of naval bases is a vital element in preparation for war, and a mobilization plan should provide for the rapid accumulation and transport of all necessary material. As matters now stand, we have not the stations and bases that our naval policy requires, nor the reserve supply of equipment, stores, and supplies to render them immediately useful in case of war.

Advance Base Outfits. In the second chapter of this series we drew attention to the fact that in Culebra (off the Porto Rico coast) and Guantanamo in the Atlantic, and in Hawaii, Unalaska, Samoa, and Guam, in the Pacific, we are in possession of a series of valuable strategic bases or outposts, the capture of which would be one of the very first objects of the enemy at the outbreak of hostilities. Our Naval Board has long recognized the importance of having a trained personnel in readiness to embark for these bases immediately upon a serious threat of war. We have the Marine Corps; but we should have on hand the advance base outfits; and the merchant vessels, suitable to serve as transports, should be listed and arrangements for their conversion into transports, etc., should be made beforehand. A few hours delay might mean the loss of an important base of operations.

The Need of a Trained Naval Reserve.

A successful plan of mobilization presupposes for its effective execution a numerous and well-trained naval reserve. *Instantly to expand the nucleus crews of the* ships in reserve to their full commissioned strength, to man the large fleet of auxiliaries, and to maintain on the receiving ships at the various yards a numerous reserve from which quickly to make good the wastage of war, would call for about double the number of men that are now by law allowed. The authorized enlisted strength of the Navy in time of peace is 51,500 men, Where, in the event of war, would the nation obtain the other 50,000? As matters now stand there would be two sources of supply: the Naval Militia and enlistment. The former represents a grand total of 7,817 officers and men, or about one sixth of the increase which would be instantly required. The other 43,000 would have to be secured by enlistment, a process which, taken in connection with the work of assembling and distributing the men, would consume many weeks of precious time and would involve delays in getting ships into commission that might well be fatal to success.

Our Naval Militia. As far back as the year 1888, the Government realized its need for an auxiliary force which might be drawn upon in the event of war, and in that year there was prepared the first naval militia bill, which failed to pass. The States, however, took independent action and organized Naval Militia forces, which, at the time of the Spanish-American war, represented a total of 4,445 officers and men, of whom, during the war, 4,000 officers and men were added to the Navy by enlistment. Most efficient work was done by the Naval Militia during that war; indeed, the "Yankee," "Dixie," "Prairie," and "Yosemite," if we except the commanding, executive, and navigating officers, were entirely officered and manned by the Militia. Since that time the Naval Militia has steadily increased in strength and efficiency, until it has reached a grand total of 7,817 officers and men, as mentioned above.

On February 16th, 1914, a Naval Militia act was passed which, according to Secretary Daniels, will do more, probably, for the encouragement of this arm of the service than any previous action of the Government. The leading provisions of the bill are that the President is authorized to call upon the Naval Militia in event of war; that the officers and men shall muster into service without further appointment or enlistment; that the Militia, when called into service, shall be governed by navy regulations; that the officers and men, when in service, shall receive the same pay as the same grade in the regular service; that the Secretary of the Navy is authorized to purchase or manufacture arms, accessories, equipment, etc., for the Naval Militia, the sum of $200,000 being appropriated for this purpose; that the Militia shall participate in cruises, maneuvers, etc., of the regular navy; that each State Naval Militia shall have at least five days for military or naval exercises each year; and that ammunition for target practice shall be furnished at the discretion of the Secretary of the Navy, the firing to be done under the direction of an officer detailed by the Secretary.

Much practical experience has been gained by the Naval Militia through the use of naval vessels loaned to the several States, and twenty-nine of these are now in use, the average cruise for which is thirty days each year. According to the Chief of the Bureau of Navigation, there is need for more ships. The vessels are old and many are withdrawn each year on account of age and for ever-recurring repairs. The Bureau believes that a type of ship of the size most suited for the Naval Militia requirements should be constructed to replace the vessels withdrawn.

This recommendation and all such for the benefit of this organization should receive the sympathetic consideration of Congress. It is eminently consistent with the spirit of the country that this body of patriotic, enthusiastic and efficient citizen-sailors should receive every assistance that can legitimately be rendered.

The Source of a Trained Naval Reserve.

While the efficiency of the Naval Militia is admitted, we have shown that its numbers are too small and its training is necessarily too limited, to enable it to provide that numerous and trained body of men which will be needed *instantly* at the *outbreak of war. In such a* crisis, the country would have to rely upon the ex-enlisted men of the Navy, who after four years of service, have passed out of the Navy into civil life. Now, while undoubtedly many ex-service men would instantly enlist at the beginning of war, much unavoidable and costly delay in manning the ships would be avoided if these men had been enrolled, organized, and assigned to their ships beforehand. These desirable conditions would be met if Congress authorized the formation of a naval reserve, the members of which would be required to put in three or four weeks of service at sea each year at full pay. As a further inducement, they might be paid, say, $5 per month during their term of enlistment.

Every year, about seven thousand thoroughly trained men, having completed their term of enlistment, are honorably discharged from the Navy and are merged and lost in the civil life from which they came. Among *these are skilled gun pointers* (worth, according to Capt. Plunkett, about $25,000 per man) quarter-masters, signal men, electricians, machinists, engineers, etc., all of them thoroughly familiar with the routine of ship life, men who, the moment they stepped aboard ship, would drop into the old routine with quick precision.

It is believed that the great majority of these men would welcome the opportunity to enlist in a Naval Reserve, and that the patriotism of the employers would find ways and means for excusing them for the annual period of drill. Such an arrangement, of course, would entail additional appropriations by Congress; but we can conceive of no direction in which the public moneys could be laid out to better advantage than this. There is every reason to believe that, by this measure, a thoroughly trained force, familiar with naval discipline and inured to the sea, would be quickly enrolled. If so, the Navy would have at all times within easy reach a sufficient force of trained men to complete the full complements of the fighting ships which are now held in reserve, in ordinary, or that are out of commission undergoing repairs.

Under the British system each man is assigned to a particular ship, and he knows to which navy yard to report upon notification. When the telegraphic term "Mobilise" has been sent out from the Admiralty and repeated throughout the kingdom, each postmaster, having the address of the various naval reserve men in his village, town, or district, instantly communicates with him. The man proceeds to the nearest railway station, where the ticket agent, upon identification, furnishes him his ticket and a prescribed amount of spending money to enable him to take the first train to the seacoast. The institution of some such method would enable our Navy Department, at the threat of war, quickly to gather all the needed reserves at the various receiving stations and distribute them aboard their several ships. Under such a system the whole of our fleet would be on its way to the [illegible] within a few days of the order to [illegible].

Within the last year, the Bureau of [illegible] established an Office of Naval [illegible] over 2,000 men have volunteered for [illegible] the opinion of the Bureau, Congress should [illegible] the formation of a National Reserve [illegible] would make the proposition attractive. If it should do so, the Bureau believes that there would be no difficulty in recruiting the full quota required in a very short time.

The Seamen of the Great Lakes. It has been suggested that a fruitful source of supply for the [illegible] of our ships might be found in the seamen of the Great Lakes. During several months of the winter the lake ports are closed and some 15,000 trained seamen are thrown out of work. It is believed that if Congress authorized a short term of enlistment, covering the winter months, a large proportion of these men, being absolutely without employment, would jump at the chance to enlist in the Navy. This body of men, being used to the seaman's life in deep water, would afford excellent material for the enlisted service. Sufficient men would be secured, probably, to man the reserve ships, which could proceed with the active fleet to the south coast of Cuba for the regular winter cruise, target practice, and drills.

Now it is believed that many of these men would remain in the Navy; and those that returned in the spring to the merchant service would probably wish to be enrolled in the Naval Reserve. In any case the country would be greatly benefited by thus interesting this body of practical seamen in the Navy, and enrolling, as it undoubtedly would, a large proportion of the 15,000 men in its trained Naval Reserve.

Drydocking in Canal Locks

By C. W. Fisher, Naval Constructor, United States Navy

ON December 12th, 1913, five submarines of the United States Navy with their mother ship or tender, the "Severn," arrived at Cristobal, Canal Zone. These boats are known as "C-1," "C-2," "C-3," "C-4," and "C-5." They were tied up alongside their mother ship, upon which the crews and officers live and mess, at one of the new concrete piers built by the Panama Railroad Company. This unique flotilla attracted great interest on account of its peculiar appearance, and its daily exercises in the harbor of Colon, where the small boats dived and maneuvered.

After four months of this duty it was found necessary to place the five submarines in drydock for the usual overhauling, testing and cleaning bottoms from the accumulation of barnacles and other marine growth. The small drydock at Mount Hope, near Cristobal, which was built many years ago by the French, and which is supposed to serve for all docking purposes until the big docks now under construction at Balboa are completed, about eighteen months hence, was unfortunately not available, on account of its being in constant use repairing the dredges at work on the big slide at Culebra. It was, therefore, necessary to devise some other scheme for docking these vessels, and it was decided to utilize one of the great locks at Gatun for this purpose.

Accordingly, on March 8th, 1914, the old "Severn," well known to many a midshipman, having served for years as a practice ship for the Naval Academy, now divested of her sails and machinery, was towed up to Gatun, accompanied by the five little submarines under their own power.

When the interesting fact became known that the very first navy vessel of any nation was about to pass through the locks of the Panama Canal and to enter Gatun Lake, large numbers of spectators gathered upon the walls of Gatun locks to witness this event, and on March 8th, 1914, the "Severn" was locked through and tied up to the approach wall of the Gatun locks in Gatun Lake, thus recording an important event in the history of the Panama Canal. On the following morning, March 9th, the submarines were locked through the east locks of Gatun and drydocked in the upper chamber.

These boats are cigar-shaped, and in order to land them successfully on the floor of the dock it was necessary to construct a cradle for each boat. These cradles were made in sections, of the exact shape of the underwater bodies of the submarines. The canal locks are not designed for use as drydocks, and, therefore, means had to be provided for holding the wooden blocking and cradles down on the bottom of the lock chamber to prevent their floating away when the chamber was filled with water. This was accomplished by bolting the sections to cross timbers placed in the culverts in the floor of the lock through which the water is admitted.

The walls of this lock chamber are [illegible] high, and vertical, and in order to accomplish the work of [illegible] the cradles it was necessary to [illegible] securely tied to the lock walls. [illegible]

[illegible] the boats [illegible] their own [illegible] chamber. [illegible] Here they [illegible] so that each might [illegible] the bows and [illegible] posts or battens to [illegible] holding the bows and [illegible] by members of the [illegible] bow and stern [illegible] under water, these [illegible] while performing [illegible]

[illegible] centered over their [illegible] the water slowly [illegible] settled in its par[illegible] was expressed by the [illegible] When the lock had been com[illegible] showed the landing to be [illegible] and the work of cleaning and overhauling proceeded.

In the midst of the work of overhauling the submarines an emergency arose requiring the docking of another vessel in this same lock. An explosion had occurred the night of the 11th instant in one of the oil tanks on the large ladder dredge "Corosal," which had been working in removing Cucuracha slide. This explosion did considerable damage to the bottom of the "Corosal," and drydocking in order to effect repairs was necessary. The "Corosal" drawing too much water to enter the drydock at Mount Hope, it was, therefore, imperative that she be docked in the other half of the chamber already occupied by the submarines. Similar blocking to that prepared for the submarines was at once installed for the "Corosal," the work being prosecuted day and night, and in four days the blocking was ready. She was docked on March 19th, 1914.

Owing to the fact that the same chamber as that occupied by the submarines was to be used, it was necessary to make some arrangement by which the submarines should not be disturbed when docking the "Corosal." The ordinary method in such cases is to float the ship already in dock and then land both ships at the same time. This, however, requires a large number of men to adjust the vessels accurately over their blockings or cradles; and it was here that the peculiar characteristics of the submarines were utilized to save time and money. Instead of floating these vessels, their tanks were filled, and they otherwise prepared themselves just as though they were to make a dive, so that when the water was let into the lock they remained securely upon their cradles, while the "Corosal" was being pulled into position over her own docking blocks.

Full crews and the commanding officers were on board each submarine, and as the water slowly rose in the lock they one by one disappeared through the conning tower hatch at the top of the boat, and took their stations below, until no one was left outside except the captain. When the water was close to the top of the boat, each captain in turn quickly entered the boat, pulled down the hatch, and as the water continued to rise, the boats were completely covered.

After the "Corosal" had been centered, the valves were again opened and the water removed from the chamber and the lock drained dry, and work at once begun upon repairing the damage caused by the explosion. This second docking in Gatun locks also brought out numerous spectators, because aside from the unexpected and unusual use of the lock chamber, the "Corosal" was one of the most important dredges working on the Cucuracha slide at Culebra.

While these two dockings were the result of necessity, as stated, and while the locks are not designed for such work, the results of these two experiences proved them fully capable of such use in addition to their designed functions as locks. And this means that in case of severe damage to any of the merchant marine or the United States Navy, these locks could be used as additional drydocks, if those to be constructed at Balboa were in use at the time.

So far as is known, this is the first time that submarine vessels have been submerged in such a way. The use of one of the lock chambers for drydocking in no way hampered the operation of the canal, since the west locks remained available for traffic in both directions.

The Problem of Three Bodies Solved

THE [illegible] of a mathematical problem is often deceiving. To one unfamiliar with the history of the case, it might be a matter of some surprise to be told that the greatest mathematicians had been baffled by that "simple" problem: To determine the path of three bodies acting upon each other according to the Newtonian law of gravitation, given their [illegible]

[illegible] two bodies is simple [illegible] be represented by a path having the form of one of the conic sections—an ellipse, parabola or hyperbola—with one of the two bodies situated at the focus, and the other traveling along the conic.

But as soon as a third body is added the problem is so increased in difficulty, that in the list of men who grappled with it unsuccessfully we find the names of practically all the greatest mathematicians since Newton, himself included. Euler, Lagrange, Laplace, Poisson, Gauss, Jacoby, Cauchy, Weierstrass, Poincaré, and Darwin all tested their powers on the task.

It has been reserved for a Finnish mathematician, Karl F. Sundmann, to furnish the long sought general solution (a number of particular solutions for special cases were known). The problem is a highly technical one, and it would be fruitless to attempt to explain in simple language the difficulties encountered and now successfully met in its solution. The artifice employed by Sundmann consists in the introduction of a new variable w in place of the time. The co-ordinates of the three bodies and the time can then be expressed as power series in w, which converges for all real values of the time.

From the point of view of mathematical theory the problem is, then, solved. But unfortunately, from a practical point of view, the solution is not satisfactory. It is not sufficiently transparent, does not readily answer the questions which the astronomer asks regarding the properties of the motion of the three bodies. The work of the mathematician in this field, though greatly advanced by Sundmann, is, therefore, not completed. No doubt others will follow along the lines which he has laid down, and, in fact, even now we can report a further advance, inasmuch as G. Armellini has extended the treatment to the case of n bodies.

Aviation in the British Army

AN important statement was made by Col. Seely recently with regard to the progress of aviation in the British army.

The present position of Great Britain may be summarised as follows:

1. The army has transferred its airships—there never were many—to the navy.
2. The army, in future, will concentrate on aeroplanes, which are being improved every day.

How many, then, of these all-necessary aeroplanes are possessed by the British army? The answer is 161, of which 100 were added during the last twelve months. There are to be eight squadrons, complete in men and machines, by the end of the coming financial year, and the total number required will be 250—50 for the Central Flying School, and 200 for the eight squadrons, twenty-five to each. But, as Col. Seely frankly admitted, if you want ten machines to be ready at a given moment, you must have twenty to draw on. Each aeroplane, in a word, must have a spare machine as its fellow, and the two can only count as one, so delicate are these machines, with so many things to go wrong and to give way.

Col. Seely also stated that he was providing for a large increase in the provision of spare parts, and for the creation of an Inspection Department. He spoke of his anxiety to do anything to lessen the risk of flying, and surprised the House of Commons by saying that there had only been six days in the year—barring Saturdays and Sundays—on which there had been no army flights; that there had not been a fatal accident to officer or man belonging to the military wing proper; and not a single breakage of any main part in the air.

The newest aeroplanes have an average speed of from sixty to sixty-six miles an hour.

The Current Supplement

IN this week's issue of the SCIENTIFIC AMERICAN SUPPLEMENT L. D. Allen writes on the manufacture and use of bearing metals.—E. E. Fournier d'Albe in an article "The Radiation Problem" gives a general survey of modern theories of radiation, with special reference to the "quantum" or "atomic" theory of light energy.—J. Whitman Bailey contributes an article entitled "A Comparison of Rivers."—The special organs by which animals are enabled to maintain their equilibrium and sense of the vertical direction form the subject of an article by W. Baunacke.—In an article on the wastefulness of coke ovens H. J. Freyn shows, among other things, how such ovens can advantageously be worked in conjunction with blast furnaces.—A profusely illustrated article is devoted to the remarkable work of Prof. Lehmann on liquid crystals, which, as our readers may recall, in many respects resemble living organisms.—The cost of electricity at the source is investigated by H. M. Hobart.—Prof. B. Hopkinson writes on the effects of the detonation of guncotton.—"Some Recent Advances in Piezochemistry" is the title of an article on chemical actions at high pressure by Prof. A. W. Browne.—The causes of Accidents with airships are discussed by E. Forlanini.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Largest Fossil Bird Known

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN of March 21st, 1914, you published an article of mine under the title "The Biggest Bird that Ever Lived." The title which I gave the article was "The Largest Fossil Bird Known." I call your attention to this difference in titles because I do not wish to assume the responsibility of calling the extinct bird that I described "The Biggest Bird that Ever Lived."

R. W SCHUFELDT.

Washington, D. C.

Increasing Motor Output

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN of March 14th, 1914, page 227, you published, under the heading "Electricity," a note calling attention to a method to increase the amount of power which a given electric motor can be called upon to furnish, and you attribute the method described to Messrs. Brown, Boveri & Co.

Permit us to state that the invention in question must be credited to Maurice Leblanc, and that it is covered in the United States in particular by two patents, 815,356 and 815,357, granted March 20th, 1906. These patents were assigned to Mr. Westinghouse.

Messrs. Brown, Boveri & Co. are our licensees.

SOCIÉTÉ ANONYME WESTINGHOUSE.

Scientific Photographs Wanted for the Royal Photographic Society Exhibition

To the Editor of the SCIENTIFIC AMERICAN:

The Royal Photographic Society of Great Britain is holding its fifty-ninth annual exhibition in August and September of this year. This is the most representative exhibition of photographic work in the world, and the Society is anxious to make it more international in character. It is very desirable that American scientific photography should be fully represented at the exhibition, and in order to enable this to be done with less work to the exhibitor, I have arranged to collect and forward American work intended for the scientific section.

This work should consist of prints showing the use of photography for scientific purposes, and its application to spectroscopy, astronomy, radiography, biology, etc. Photographs should reach me not later than Friday, July 10th. They should be mounted, but not framed.

I should be glad if any worker who is able to send photographs will communicate with me as soon as possible so that I might arrange for the receiving and entry of the exhibit.

C. E. KENNETH MEES

Research Laboratory, Kodak Park, Rochester, N Y.

Relative Cost of Tunnels and Bridges

To the Editor of the SCIENTIFIC AMERICAN:

The paragraph headed "Tunnels Versus Bridges" in the issue of March 28th, gives an erroneous impression while purporting to correct one. It considers the "capacity for a given cost" of a bridge and of a tunnel as proposed for the North River, and states what would doubtless be true, that "a bridge would accommodate five or six times as much traffic as could be sent through a tunnel," but it omits to state the equally important fact that the bridge is estimated to cost about five or six times as much as a *pair* of tunnels. Moreover, with a bridge this great carrying capacity is concentrated at one point, so that if it is to be used to its full capacity much of the traffic would have to make long journeys in order to reach the bridge, and again in order to reach its destination after crossing it. On the other hand, the several pairs of tunnels (one for traffic in each direction), which could be built for the cost of one bridge, would be distributed along the river so that the traffic could, in the average, pursue much more direct routes between the points of origin and destination.

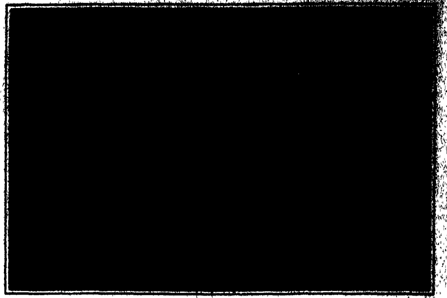
I call these facts to your attention, believing that you always desire to be fair to both sides of every question.

Media, Pa. JOHN LODGE.

[A North River bridge, costing $76,000,000, would have a capacity equal to that of nine pairs of tunnels costing, at $20,000,000 per pair, $180,000,000. Hence, the cost per single track would be two and one half times as much for eighteen single tunnels as it would be for a bridge of equal capacity.—EDITOR.]

It is predicted that western yellow pine will furnish an excellent source of turpentine as the southern pine becomes exhausted.

Forge furnace heating heavy work for the hammer.



Forge furnace burning a blast of coal dust. A great saving of fuel.

Powdered Coal for Fuel

Burning Coal Dust in Jets Like Oil

By Harry N. Holmes

THE use of powdered coal as a fuel has been developed to successful practice. It possesses all the advantages of burning an oil spray and the additional one of greater economy. Like oil, it is blown into the combustion chamber intimately mixed with a blast of air and is there completely burned with little or no smoke.

The comparison of values is interesting. Assuming that there are 19,000 British thermal units in a pound of oil and an average of 13,500 British thermal units in a pound of bituminous coal, and that gas producers will give 85 per cent efficiency, the following values are deduced: Oil at 4¾ cents per gallon, 28,600 British thermal units for 1 cent; producer gas from coal at $3.10 per ton, 69,673 British thermal units for 1 cent; powdered coal, slack, at $2.75, 98,181 British thermal units for 1 cent

To further this economy in operation a minimum of *attention is required, for the best equipment is almost* automatic in many details. Oil stoking requires little attention, and the two operations are similar in this as in other respects The absence of smoke is the natural result of the perfect combustion, as every minute particle of coal dust is completely burned in a proper installation. The intense heat obtainable by this coal dust jet will develop many special applications. One of the greatest advantages of this method of furnace firing is its adaptability to any grade of fuel, even coal that has no value on the grate bars. Anthracite, bituminous, lignite, coke breeze, all are grist to this sort of mill Experts consider that coal with 45 per cent ash has no steam raising value whatever when burned in the old way, but Barmhurst has obtained profitable results with coal of 52 per cent ash in a coal dust jet. This method of firing makes possible a tremendous development *of the low-grade coals of the West.*

There are four simple requirements which absolutely must be obeyed:

First—The coal must be dried so that it contains not over one per cent of moisture.

Second—The coal must be pulverized to a high degree of fineness

Third—It must be blown into a chamber hot enough to cause instant deflagration

Fourth—It must be supplied with air sufficient to yield the oxygen necessary to burn the carbon of the coal at once to carbon dioxide.

Drying the coal is essential for two reasons Coal containing much more than one per cent moisture is not easily ground to a fine powder. Furthermore, if this moisture were not removed in a drying oven it would be converted into superheated steam in the most expensive place for such energy consumption - the combustion chamber. This causes a very great loss in efficiency Fine grinding is essential in order to increase the free surface of every pound of coal Rapidity of combustion depends on this intimate contact of air and coal which is possible only with extremely minute particles. Very efficient grinding machines are on the market, producing any degree of fineness desired Some engineers consider that if 85 per cent of the dust passes a screen of 100 meshes to the linear inch, that is, each mesh is 1/100 of an inch square, the combustion results by this method will be satisfactory. Others make more rigid requirements, insisting that 85 per cent should pass a screen of 200 meshes to the inch.

Barmhurst states that 85 per cent of the dust will pass a 400-mesh screen and fully 70 per cent a 600-mesh screen, when ground by the best machines. Considering that each particle is a cube 1/600 inch on edge he estimates that a cubic inch of coal may break up into 216,000,000 such grains of dust. The surface exposed to air by a block of coal one inch on a side is only 6 square inches, hence such a cube burns slowly. The surface of this same cubic inch in the finest powder exposed to air in an intimate mixture is 3,600 square inches. Rapidity and completeness of combustion in the latter case is to be expected.

Too great a velocity of the fuel mixture does not permit the coal to develop its heat near the point of ignition where it is most needed, that is, at the entrance of the coal into the combustion chamber. To insure perfect combustion every pound of carbon needs 2 2/3 pounds of oxygen, which is found in 154 cubic feet of air. If less air is supplied much of the carbon burns to carbon monoxide, which escapes *from the stack or* burns in the stack without benefit. To utilize all the energy of the fuel the carbon must burn to carbon dioxide in the combustion chamber. Because of the extremely high temperatures obtained with coal dust, excess air is usually admitted to cool the gases somewhat. From 50 to 100 per cent excess is common in the best practice. When one pound of carbon burns with exactly 2 2/3 pounds of oxygen combustion should be complete, and, theoretically, a temperature of 4,859 deg. Fahr. be obtained, but with 4 pounds of oxygen, or 50 per cent excess, only 3,326 deg. Fahr. should be obtained, and with 100 per cent excess only 2,529 deg. Fahr. The color of the flame is a guide to the stoker in regulating the amount of air required for maximum efficiency. A short white flame is the hottest. The furnace must be so designed that the fuel shall be thoroughly consumed before its resulting gases are brought in contact with the work to be done, otherwise particles of unburned carbon will be chilled and appear as smoke.

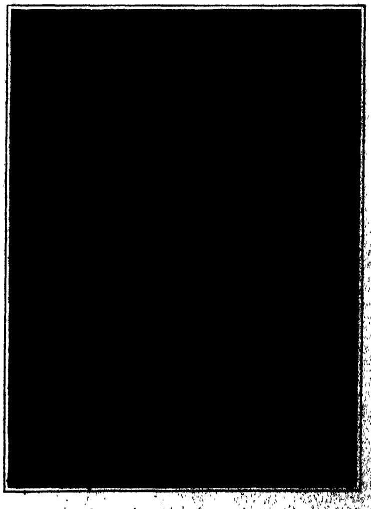
The process and machinery required are outlined by one of the best engineering companies as follows:

The coal is received in the pit of an elevator. This elevator carries it to the hopper of a pair of crushing rolls. Under this hopper may be an automatic weigh scale. From the hopper the fuel passes to an indirect fired coal drier. This drier must be of a size to deliver the required quantity continuously thoroughly dried. The drier is heated by a slow fire upon grates so arranged as to avoid igniting the drying coal. The cylinder of the drier is rotated by a small electric or steam motor. From the drier the coal drops into the pit of an elevator which carries it to a mill bin, set aloft. By spouts and gates the coal enters the pulverizer. By another elevator the fine dust is carried to the storage bins for powdered coal. These bins should hold enough to last during intervals that the pulveriser is not running. The coal is taken from the bottom of the bins by a worm feed screw, provided with a variable drive.

The feed screw delivers it into the burning pipe into which it falls. A fan forces a volume of air through the burning pipe, intimately mixing with the coal dust falling from the feed screw. The volume of air is easily controlled by either varying the fan speed, or by a blast gate.

There is no danger of a coal dust explosion such as occurs in mines, for the air and coal dust are not mixed until just as they enter the furnace at high velocity. A "puff" cannot take place against this inrushing column of air and coal. The air is introduced before the coal is turned on, and the coal is shut off before the air. If coal is introduced faster than it will burn, a great quantity of gas is distilled and gives the effect of an explosion, quite harmless, however. When the hot gases impinge directly on firebrick a cooling system of water-cooled pipe set in the walls may be necessary to save the brick.

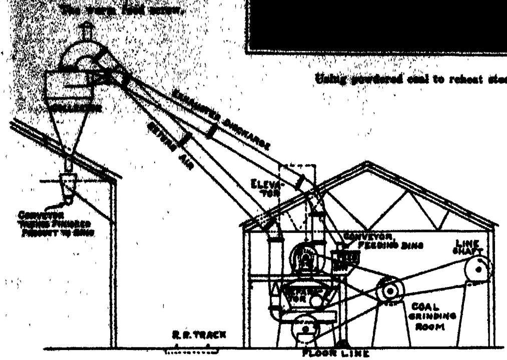
English practice in burning powdered coal differs somewhat from that used in America. The English favor a boiler, which uses rather coarse coal dust, containing up to 15 per cent moisture, for steam raising. Their practice is not to pulverize lump coal, but to utilize the screened dust from the mines, low in price, and reduce it to a powder not nearly so fine as that demanded by the American type. This practice



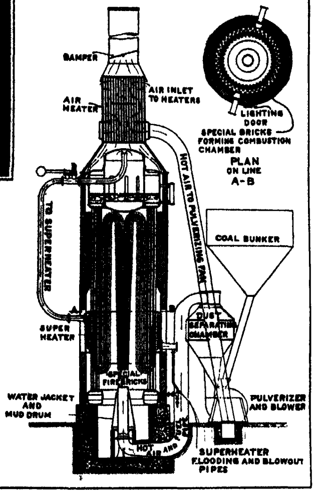
English type of boiler burning coarse coal dust.

[illegible]

Using powdered coal to reheat steel billets.



Typical mill for grinding coal and conveying it pneumatically to storage bins.



Cross section of the English type of boiler.

ing is done in a "beater" by fan blades of manganese steel at a speed of 1,500 revolutions per minute. Sufficient air is admitted in the beater for purposes of combustion. The fine particles are blown into the furnace through a nozzle. The coarser separate by gravity and are thrown back into the beater until reduced to the proper degree of fineness. There is no expense for drying unless the coal is above 15 per cent moisture.

The difficulties that delayed the development of a successful dust boiler are:

1. The difficulty of maintaining continuous and steady ignition, a difficulty met only by maintaining a uniform and very high temperature in the furnace.

2. The failure to find an economical material to stand the destructive temperature necessary as hitherto arranged for boiler firing.

3. The difficulty of producing a continuously homogeneous mixture with varying grades of coal, sometimes very wet and high in ash.

4. The difficulty of maintaining a homogeneous mixture of fuel dust and air during the full period required for complete combustion, the tendency of the larger solid particles being to concentrate in certain lines of direction, a difficulty met in part by extremely fine pulverization of the coal.

5. Difficulty of handling the molten ash which must usually form solid deposits of slag.

These troubles are overcome in the boiler here shown. It is of the vertical type and the tuyere is at the bottom, forcing the fuel dust and air with which it is mixed upward against the water tubes and brickwork at the top of the boiler. Thence the stream is turned down, enveloping the entering mixture with the highly heated products of combustion, and thus maintaining a regular ignition. The air mixed with the dust weighs about eleven and one half times as much as the coal and enters at considerable velocity. Since gravity and momentum act in the same direction in vertical firing there can be no separation of larger from smaller particles, a distinct advantage over horizontal firing. Of course the path of the particles is just great enough to permit the complete combustion of all the fuel. As in the American type it is necessary that the furnace be lined with brickwork of a highly resistant nature, not only to withstand the terrific temperatures, but to keep the fuel ignited by their incandescence.

Boiler tubes are built into the fire brick and, since they are vertical and a rapid stream of water is circulated, they collect very little scale. This is mostly formed in the bottom header where it can easily be blown off.

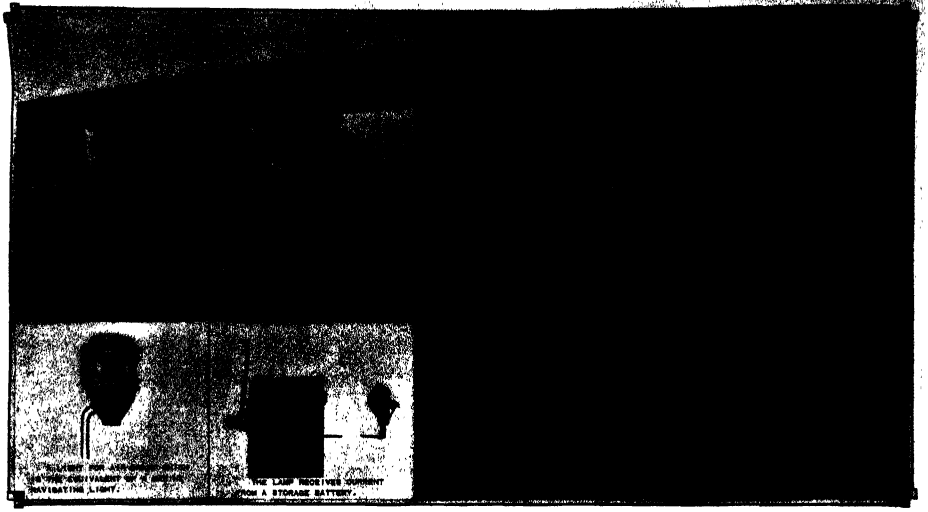
The Taxicab Service of New York City

By Harry Chapin Plummer

TRULY magnificent distances are those compassed by Father Knickerbocker in that vehicle which is so characteristic of the twentieth century—the taxicab. There are three thousand of those restless, snorting, erratic conveyances in service in the streets of Greater New York, and, barring a limited area in the Borough of Brooklyn and isolated sections of the Bronx and Queens, they are mostly all concentrated in the district

(Concluded on page 336.)

If a single taxicab could do all the work of New York city's three thousand, it would make nearly two round trips to the moon in one year.



Aeroplane lamps with lights of different colors, for showing their path and signaling their position when flying at night.

Aeroplane Lamps

A Light That Shows "Port" and "Starboard" and Also Throws White Beams Forward and to the Rear

By Dr. Alfred Gradenwitz

DIRIGIBLES are generally equipped with lamps fixed to the right and left, respectively, which, like those of ships on rivers or at sea, indicate the direction of traveling by red and green lights In a similar manner, it would be desirable to fit aeroplanes with two lamps giving out lights of different colors, thus enabling their position on the ground and their path through the air to be signaled and collision with other air craft to be prevented.

A manufacturer in Berlin has designed a special aeroplane lantern which would seem to comply with all requirements to be satisfied by such lamps While constituting no material extra load on the aeroplane and needing, under way, no attendance or supervision, it allows its position or direction of flight to be ascertained with all desirable accuracy.

This aeroplane lamp comprises a lantern casing inside of which there is arranged a 10 candle-power metal filament lamp whose light is so reinforced by an annular lens, that the luminous intensity actually given out amounts to about 40 Hefner candles The lamp is plainly visible, even in foggy weather, to a distance of about three miles Since the light is given out uniformly on all sides, the lamp is surrounded by a luminous ring. In order also to signal the direction of flight by means of this lamp, red and green glasses are so arranged in the interior of the annular lens that the forward portion of the luminous ring (about 10 degrees) appears white, whereas the adjoining part to the right (about 110 degrees) is colored green and the left-hand part of equal length, red The rearward portion between the red and the green parts (about 130 degrees) again gives out a white light This simple arrangement of the optical system enables any aeroplane equipped with the lamp to be sighted (and its direction of flight ascertained) at sufficient distance, the observer seeing more or less of the red or the green light beside the white.

The metal filament lamp is so designed that heavy shocks, as produced on landing, will exert no influence on it Moreover, its fitting is carried by a substantial spring, damping any jerks.

The incandescent lamp is fed from an Edison accumulator, arranged close to the driver's or observer's seat, which complies with all requirements of the case Replenishing with potash is only necessary every eight to twelve months, according to the actual strain on the accumulator. Refilling is effected exclusively with pure distilled water. Inclinations up to 45 degrees and heavy oscillations will not do any harm to the accumulator, nor will the electrolyte flow out. Recharging can be effected anywhere, the accumulator being readily removable.

It is recommended that the accumulator feeding the aeroplane lamp should feed at the same time a lighting plant for illuminating the instruments near the airman's seat, such as the speedometer, pressure gage, clock, gasoline gage, etc A 2 candle-power incandescent lamp fitted with a reflector and red glass pane is sufficient; in this connection red light being preferable in order that the airman may not be dazzled.

Each charge of the Edison accumulator suffices for feeding the aeroplane lamp and instrument lighting plant during seven lighting hours. The current supply to the aeroplane and instrument lighting lamps, respectively, can be switched in separately from the airman's seat. Whenever required, a keyboard may be inserted into the aeroplane lamp circuit, thus allowing signals to be given by its aid.

The whole lighting plant of an aeroplane, as above described, weighs about 10 kilogrammes (22 pounds).

Military Aviation in France

FROM a recent discussion of French military aviation in the *Engineer* and *Le Temps* we gather that there has been a serious crisis in the French aeroplane industry, accompanied by a disorganization of the military aviation department, where the apparent absence of method, and the poor results obtained after the expenditure of huge sums of money, have given rise to severe criticisms in the Senate. In the past two years 677 aeroplanes were purchased, and of these 175 were paid for by public subscription. Nevertheless, it is widely admitted that the aviation corps is wanting in homogeneity and efficiency. A mistake was made in trying to centralize everything relating to the technical development of the aeroplane and dirigible balloon at Chalais-Meudon. This department was perhaps a little too exacting at a time when the construction of aeroplanes was not so well understood as it is at present. Having fixed a standard of its own, and being unable to get aeroplane manufacturers to build machines to a new specification, Chalais-Meudon embarked upon the construction of a special type of military aeroplane. A large number of machines purchased from private builders were broken up within a month or two of delivery on the ground that they were lacking in structural strength. It is true that this action seemed to be justified by the alarming number of fatal accidents that had happened to military pilots. Chalais-Meudon has certainly not done better. The Minister of War has therefore given particular prominence to the reforms which it is proposed to carry out, such as the decentralization of the military aviation department and the offering of encouragement to private makers to co-operate with the military authorities in the building of suitable types of military machines. The present tendency is to develop an armored aeroplane which, in the words of the Minister, will be an "aerial destroyer." Improvements in aeroplanes and the organization of the military service on a sound basis require so much undivided effort that it has been decided to separate the aeroplane from the dirigible balloon, to which much more attention will be given in the future. Instead of sacrificing one to the other, both will be developed independently. The French government is having plans prepared for rigid dirigibles of 30,000 cubic meter capacity.

A Technical Museum for New York

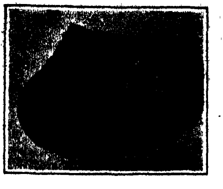
THE prospects that New York will have a museum comparable with the splendid Deutsches Museum of Munich are bright. It is announced that there will be established a group of twenty separate museums of as many industrial arts, to be known as the "Museums of Peaceful Arts." The proposed museums will cost $20,000,000, of which, it was said, the incorporators prospectively had already reason to count on about $1,500,000 as a nucleus. The objects of the corporation are given thus:

To establish and to maintain as a permanent and useful memorial of the century of peace and amity that has followed the signing of the Treaty of Ghent on Christmas Eve, 1814, in the city of New York, and for the people thereof, and for the benefit of the citizens of the State of New York and of the United States generally, buildings which shall be devoted to the housing and proper exposition of permanent exhibits in the following branches, among others, of the industrial and peaceful arts:

Electricity
Steam
Astronomy and Navigation
Safety Appliances
Aviation
Mechanical Arts
Agriculture
Mining
Labor
Efficiency
Historic Records
Health and Hygiene
Textiles
Ceramics and Clays
Architecture
Scenic Embellishment
Gardening
Roads and Road Building Materials
Commerce and Trade
Printing and Books.

A Sacred Clam Shell

THE clever priests of China often insert tiny images of Buddha within the shells of a living clam, which are left undisturbed for about a year. At the expiration of that time the images are covered with mother of pearl to such an extent that they appear to have grown in this natural manner. The Chinese people hold these shells in great reverence, believing that Buddha dwells within them. However, should a Christian chance to look upon one of the shells, it has no further value to them, as its charm is supposed to have left it.



Images of Buddha coated with pearl.

Afloat on the Dead Sea.

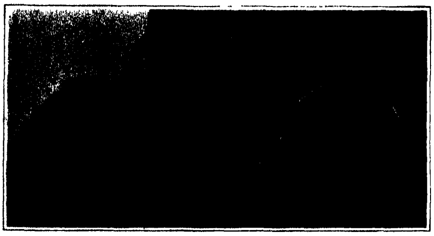
First Aeroplane in Jerusalem

DURING the last few months the aeroplane has made its appearance in many strange places, not the least among these being the ancient city of Jerusalem. It was during his flight from Constantinople to Cairo that M. Bonnier, the French airman, passed over the Holy City in his monoplane, descending upon the historic plain of Rephaim, a short distance south of Jerusalem. It was on this plain that King David met and defeated the Philistines. Never, in modern times, was the city so excited. It poured out *en masse* to see the airman and his machine—Christians, Jews, and Moslems. Our photograph depicts the airman about to leave for Cairo. The Holy City may be seen on the extreme left and the Mount of Olives on the right.

The first aeroplane in Jerusalem.

Revolving Cylinder Motor on a Motorcycle

THE revolving cylinder internal combustion motor, which failed so dismally on the single make of automobile on which it was used, but which since has "proved" itself in connection with the aeroplane, is due to have a tryout in motorcycle service. A machine mounting a three-cylinder motor of that type has been developed by a Connecticut inventor who now is completing arrangements to manufacture the machine in great numbers.



Motorcycle fitted with a revolving cylinder motor.

The motorcycle, which is pictured herewith, does not differ widely, exclusive of the motor, from accepted practice. The motor is mounted inside the rear wheel and concentric with it, so that the cylinders revolve in the same plane as the wheel. It is geared to the wheel by means of spur gearing, the ratio being four to one. In common with aeroplane motors of the same type, the carbureter supplies the mixture directly to the base chamber through a hollow shaft, whence it is admitted to the proper cylinder through the inlet valve, which is positioned in the piston and operated by means of a cam placed on the upper end of the connecting rod. The exhaust valves are in the heads of the respective cylinders, being operated by means of a stationary cam, tappets and tappet rods in the usual manner. Silence is approximated by causing the exhaust gases to pass through a series of comparatively small holes before emerging from the valve pocket. Ignition is effected by means of a set of batteries and a single coil operating in conjunction with a high tension distributer. While the maker claims that with a motor of this type it is perfectly possible to lubricate all parts by mixing the requisite amount of oil with the fuel, as is commonly done with two-cycle motors, for the present that system has not been adopted, and the oil is fed to the crankcase by means of a sight feed drip, and is circulated to the various parts by means of centrifugal force. A free engine clutch of the cone type serves to disconnect the engine from the wheel; it is operated by means of a lever on the handlebar.

The advantages claimed for the construction are manifold. Chief among them is light weight. The motor, which develops nine horse-power when run at normal speed, weighs about thirty-one pounds, and it is said that the motorcycle complete weighs fully a third less than any twin now on the market. Another big feature is the total absence of vibration, for the three radiating cylinders are perfectly balanced and there are no reciprocating parts with relation to the frame of the machine; hence the motor is perfectly balanced. In this connection, it is well to add that the intervals between the firing of the cylinders being equal, another reason for smooth operation and reduced vibration is evident By the same token, the torque is more nearly constant and the motor can be throttled down and run slower than even the best regulated twin. Other features claimed are certainty of cooling, for the cylinders constantly cut the air, whether the motorcycle is moving or not, and the elimination of drive chains with their accompanying noise and dirt The placing of the motor in such an out of the way position opens the way for the adoption of an open frame model for women riders.

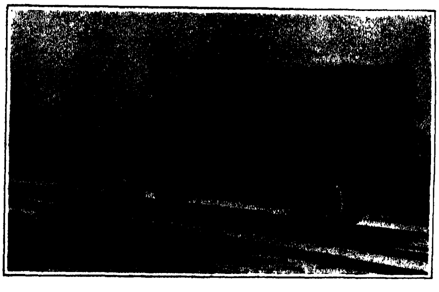
The apparent disadvantages of the type are inaccessibility of the vital parts, for the motor is closed in by the spokes, unequal distribution of weight, with the greatest amount on the rear wheel, tending to cause skidding; the delicate parts mounted where vibration is greatest and where there is no springing, which is not conducive to longevity Whether the advantages gained will be sufficient to outweigh the disadvantages, time will tell.

Floating on the Dead Sea

THE wonderful buoyancy of the Dead Sea, that strange inland sheet of water in Palestine, is proverbial It is some 47 miles long by 9 miles wide, and lies no less than 1,200 feet below the surface of the Mediterranean, the lowest-lying lake on the face of the globe Its waters are so bitter that fish cannot live in them We get an idea of its density when it is stated that in a ton of water from the Atlantic there is 31 pounds of salt against 187 pounds from a like quantity in the Dead Sea The result is that it is impossible for a human being to sink in these waters, and the accompanying photograph depicts a tourist reading his guide book while floating on the surface of the water

Mexican Armored Motor Car

THE accompanying photograph shows a standard American two-ton motor truck chassis which has been converted into a motor car by the Mexican Constitutionalists.

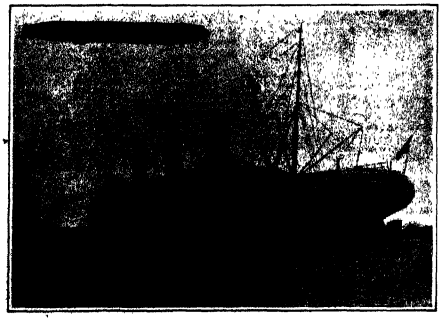


An armored motor car.

It was not known to what use the chassis was to be put when delivery was made to a southern dealer, but the result pictured is a striking reminder of the adaptability of the motor chassis, and shows the ingenuity displayed by the progressive Constitutionalists Interior space of the armored body is used for carrying ammunition, rifles, etc., while the deadly fire of machine guns can be directed through small portholes in the walls The car is fitted with armored wheels for operation upon the railroad, where a continuous stretch of track remains, or by quick adjustment the wheels can be changed to run over the roads directly into the *Zona Guerra.*

Two of the World's Seven Wonders

A SPIRITED voting contest has just been concluded in Germany to decide which are the seven wonders of the twentieth century. After the enormous volume of votes cast were counted, it was found that the majority had placed the wireless telegraphy at the head of the list and the Panama Canal second. The third of the seven wonders, it was decided, is the dirigible airship, next in order the flying machine, radium, the cinematograph, and the steamship "Imperator." An extraordinary photograph is reproduced herewith which shows two of the seven wonders of the modern world in close proximity By a lucky chance the photographer has caught the dirigible airship "Hansa" and the "Imperator" on the same plate The great airship, which measures more than 500 feet in length, was on one of her regular air cruises at the time she passed over the steamer.



A giant of the sea and a giant of the air.

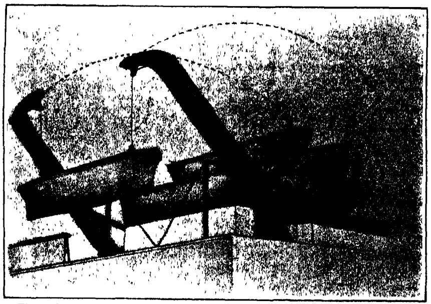
Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

Lifeboat Arrangements on the "Britannic"

IT is certain that, up to within the last two or three years, the development of the lifeboat and its means for launching has lagged far behind the development of the ocean liner itself To-day, however, a great deal of thought is being directed, not merely to the construction of the lifeboats themselves, but to the provision of strong and effective means for getting them quickly and safely overboard, even when they are loaded to their full capacity We present two drawings which show the admirable way in which Harland & Wolff have worked out the problem on their new liner, the "Britannic," which will make her maiden trip to this port during the present year The lifeboats are nested, two deep, in groups of five, and each group is served by a pair of powerful electrically-operated davits. The old boat davits have always seemed to us to be rather primitive affairs, lacking in the necessary strength and rigidity, but no such charge can be laid against the installation on the "Britannic." The main members of the davits are of stiff lattice work construction, hinged at the decks and capable of swinging through a wide arc. Each pair can be swung over so far inboard that it can pick up a lifeboat from the center of the ship and swing it out so far outboard that the risk of its being crushed against the ship's side is practically eliminated. Access to the boats is gained by stairways which lead to platforms running between the several tiers of boats, from which the passengers can step conveniently into place. These stairways and platforms are not shown in our illustration; but they are sc arranged that the loading of the boats can be expeditiously done and without any confusion or crowding. The boat lowering gear is driven by electric motors of such power and so arranged that the lowering can be done very speedily, the boats being maintained on an even keel and released immediately on reaching the water.

The powerful davits of the new White Star liner "Britannic."



These davits can pick up a boat that is amidships and swing it entirely clear of a rolling ship.

A Smoke and Fume Monitor

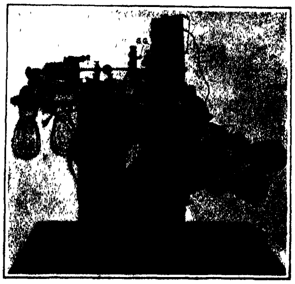
By W. W. Strong

MANY furnaces are not placed so that the fireman can see the top of the smokestack. Neither does the manager of the power plant often see the black fuel issuing from the top of the stack In other words, small account is given to this item of waste and the source of a fume and smoke nuisance in many cases

Naturally a fireman is not careful about the part of his work to which no one pays any attention The result is carelessness, and it is to this carelessness and lack of interest that much of the trouble of smoke inspectors is due. The purpose of the smoke monitor is to furnish an ever-present educational guide to the fireman, a conscience ever ready to prick at his contentment if he is not firing properly. The smoke monitor rings a bell and turns on a red light at the furnace door when the furnace is emitting smoke of a density forbidden by the city ordinance The smoke monitor works day and night, and a recording mechanism can be attached to it Besides the smoke monitor there should be a set of directions telling the fireman just what to do when the bell is *ringing*

The smoke monitor is a very compact piece of apparatus, and is entirely electrical in its action It uses from 60 to 100 watts of energy, and this is the only cost of maintenance, since there are no moving parts to the apparatus to get out of repair

In the illustration the monitor is shown with all the parts together, though it is probably more convenient to place the bell *B*, the red lights *RL*, and the relay *R* by themselves, while the transformer *T* is placed near the stack The transformer is a comparatively light one, giving about 20,000 volts potential (when on the 110 circuit) across the spark gaps *SG*. In parallel with this spark gap is a similar one placed in the smokestack. When there is little, if any, smoke in the stack the resistance is low and the discharge takes place in the stack When smoke of a given density (say one third black) appears in the stack, the resistance is so increased that the discharge takes place at *SG*, and this discharge is a series of oscillatory sparks The remainder of the apparatus consists of a coherer and relay and operates in the same way as in wireless telegraphy, turning on a bell and red lights whenever sparking takes place at *SG*. The apparatus can easily be carried about There are few adjustments necessary, these being the proper setting of the spark gap electrodes, the relay and the coherer. When there is no smoke issuing from the furnace fires, the instrument is perfectly quiescent As soon as smoke appears, the bell and red lights are turned on and remain going until the smoke ceases to be emitted The relay could be made to operate any other similar device such as draft mechanism, steam jets, etc



Instrument that sounds an alarm when a stack emits too much smoke.

Possibilities in Brush Invention

By H. M. Baxter

THE manufacture of brushes offers unlimited fields for the inventor, both in the production of a material to replace hog bristle, which is constantly growing more scarce and higher priced, and in the method of making the various sorts of paint, varnish, lather, hair, clothes and other brushes.

The following information regarding past efforts and present needs may be of assistance to any who wish to go into the matter.

Probably the most pressing need is for a rapid, inexpensive method of setting paint and varnish brushes. This setting or fastening must be absolutely impervious to the action of all liquids, including water, oils, alcohol, French spirits, turpentine, and the various distillations of coal oil, and should not necessitate the application of either heat or pressure. It should be adaptable to round, oval and flat brushes of all sizes and lengths.

The system of vulcanization is objectionable on account of its cost and because of the extreme heat required, which is naturally more or less injurious to the bristle. Furthermore, the vulcanizing process requires several days, delaying the manufacture.

Since the making of the first brush, a good setting has been striven for by all brush workmen and manufacturers. Most of these efforts have been to produce a cement that would dry, say, within twelve hours, or over night, and after drying, would resist the action of all liquids.

This result has been attained several times, but to make such a cement adaptable to present brush-making methods, it must remain in suspension, in an open, shallow pan, on the brush-maker's bench, throughout the working day, and so far there has been no single material which meets all these requirements.

Practically all bristle used in brush-making is produced in Russia, Germany, France, Siberia, and China. During the past five years there has been a steady increase in price with a corresponding scarcity in supply and depreciation in quality. Hair from horses' and cows' tails, various sorts of vegetable fibers from tropical trees, split quills from feathers, carefully tapered and prepared, and many other expedients, have been tried with little success, though many of them are used to adulterate the costly bristle.

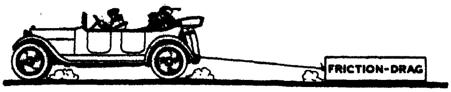
Some of the substitutes lack the requisite elasticity, others are too stiff and leave marks in the paint and varnish. And none of them possesses the marked "affinity" for oils and varnish that characterizes the hog bristle. Owing to its peculiar cellular formation and its natural oils, the "flag end" of bristle is a perfect paint and varnish smoother and distributer. This flag end consists of a tiny split or division into several parts of the outer end of the bristle, probably caused by the intense cold, in an endeavor to create a mat of warmth for the hog Therefore, a substitute for hog bristle must have some sort of satisfactory spreading power, to correspond with the "flag end." It must possess great strength and elasticity, so as to carry and spread a heavy load of oil and lead paint, yet must be fine enough to not leave marks in the paint or varnish. It must also have, to some degree, the power to pick up, carry along, and discharge gradually, a heavy load of paint, which is the most marked and valuable characteristic of hog bristle, owing to its cellular construction and oily nature.

A Simple and Convenient Fish Rod

AN ingenious combination of a spring balance and fishing rod can be made without disturbing the general appearance of the rod. All that is needed is to hollow the end so as to make a regular tube, or else fit on a short piece of tube. Part way up the tube is attached a spring, and the lower end of the spring carries a short hook for hanging the fish. The weight of the fish thus draws down the end of the spring in the same way as in the usual spring balance, and by cutting a small window in one side of the tube, a scale can be put on a piece of glass fitted in the window, corresponding to a pointer attached to the spring. The whole is simply a spring balance, built into the end of the fishing rod, and it is all inclosed and not in the way at ordinary times.

"Give me a quart of oil"

This careless request may bring costly penalties



The garage man comes out.

The motorist says, "Give me a quart of oil."

His "quart of oil" is poured into the crank-case or reservoir. The car goes on.

No doubt the motorist thinks he has amply protected the 1500-odd parts of his motor.

Far from it. *One of the surest ways to invite friction-drag and motor trouble is to say, "Give me a quart of oil."*

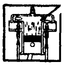
"Give me a quart of oil" *invites* Loss of Power

Escape of explosion past the piston rings, loss of compression and loss of power frequently result from oil of incorrect *body*. The power-loss is felt most on heavy roads and on the hills.

You can get full compression—complete power—only by using oil whose *body* suits *your* motor.

Correct *body* is seldom secured by saying, "Give me a quart of oil."

"Give me a quart of oil" *invites* Scored Cylinder Walls



Scoring frequently results from oil of low lubricating *quality*. Often, also, the oil's *body* is too light. Then the cylinder walls *have no protecting film*.

Scratching results.

Too often the blame can be traced straight to "Give me a quart of oil."

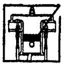
"Give me a quart of oil" *invites* Wear of Bearings

The problem of bearing-lubrication is far from simple. Bearings differ widely in type and size. The oiling systems which supply them also differ. Adjustments vary.

Both the *quality* and *body* of the oil must suit these conditions. For every oil that suits your motor bearings, you will find many which will cause undue friction.

An almost sure start toward bearing-trouble is, "Give me a quart of oil."

"Give me a quart of oil" *invites* Wear of Wrist Pins

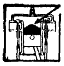


Wrist-pin lubrication is a difficult problem and little understood.

The location of the wrist-pins within the heated pistons and the slight angular motion of the bushings demand an oil which will spread readily, yet maintain the proper film between the pins and bushings.

Quick damage will come if the oil fails to meet these conditions. To encourage wrist-pin troubles prematurely, it is only necessary to say, "Give me a quart of oil."

"Give me a quart of oil" *invites* Carbon Deposit



Guesswork won't eliminate this trouble.

Both the *quality* and the *body* of the oil must be considered.

Suppose the *body* is too light for the piston clearance. The oil then works too freely into the combustion chambers. In burning, excess carbon accumulates unless the oil's ash is light and naturally expelled through the exhaust.

An easy road to carbon trouble is, "Give me a quart of oil."

"Give me a quart of oil" *invites* Noise

Noise is often a sign of worn parts—resulting from friction.

It may be a dull "thump" at every revolution of the main shaft. It may be "knocking" of worn wrist pins. It may be "hissing" within the cylinders. It may be "knocking" caused by excessive carbon deposit.

When a comparatively-new car pounds and racks its way along the roads it is seldom necessary to ask what brought on premature old age. Generally it is undue friction—resulting from incorrect lubricating oil. A way to invite premature noise is an off-hand request, "Give me a quart of oil."

"Give me a quart of oil" *increases* Maintenance Cost

If the oil's *quality* is low, a larger quantity is necessary to maintain a film.

If its *body* is incorrect, you have incomplete protection for the moving parts.

In either case excessive friction-drag results. Fewer miles are obtained from each gallon of gasoline. Your fuel and repair bills mount up.

This common waste is the frequent result of "Give me a quart of oil."

"Give me a quart of oil" *reduces* Second-Hand Value

What fixes the selling price of a used car? (1) The condition of the motor. (2) The condition of the chassis. (3) The condition of the body.

The motor is the vital part of the car. The motor condition, therefore, is most important.

At a recent sale in New York City, second-hand cars of uniformly prominent makes were auctioned off. The bodies were in good condition. The prices of the cars originally ranged from about $2000 to $5000. *The selling price in some cases was as low as $100.*

Why? Because the motors and other moving parts were badly worn

Was the wear due to long service? No. The age of most of these cars disproved that. *Premature* wear was evident.

It is safe to say the owners of these cars had used the common expression—"Give me a quart of oil." They paid a high price for their carelessness.

How to secure the correct oil for your car

Do not say, "Give me a quart of oil."

You want an oil whose *body* is correct and whose *quality* is best suited to the requirements of your motor.

Ask for that oil and get it.

Below we print, in part, our Chart of Automobile Recommendations.

This Chart is the result of the most far-reaching and thorough study of automobile lubrication that has ever been made.

It was prepared by a company whose authority on scientific lubrication, for every class of machinery, is recognized throughout the world—The Vacuum Oil Company.

It was prepared after a careful analysis of the motor of each make and model of American and foreign car

For a number of years this Chart has been the standard guide to correct automobile lubrication.

The superior efficiency of the oils specified has been thoroughly proven by practical tests.

Make a note of the grade of Gargoyle Mobiloil specified in this Chart for your car. Then make sure that you get it.

You will then give your motor oil of *body* and *quality* which will yield you the fullest power, the greatest freedom from friction, and the greatest pleasure in motoring.

If your car is not listed below, send for our *complete* Chart of Recommendations.

In buying Gargoyle Mobiloils, it is safest to purchase in original barrels, half barrels, and *sealed* five-gallon or one-gallon cans.

Look for the red Gargoyle on the container.

On request we will mail a pamphlet on the Lubrication of Automobile Engines. It describes in detail the common engine troubles—and gives their causes and remedies.

The various grades of Gargoyle Mobiloils, purified to remove free carbon, are.

Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
Gargoyle Mobiloil "E"
Gargoyle Mobiloil "Arctic"

They can be secured from reliable garages, automobile supply houses, hardware stores, and others who supply lubricants

For information, kindly address any inquiry to our nearest office

VACUUM OIL CO., Rochester, U.S.A.

Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world

BRANCHES

DETROIT
Ford Bldg
PHILADELPHIA
4th & Chestnut Sts

BOSTON
49 Federal St
INDIANAPOLIS
Indiana Pythian Bldg

NEW YORK
29 Broadway
MINNEAPOLIS
Plymouth Bldg

CHICAGO
Fisher Bldg
PITTSBURGH
Fulton Bldg

A guide to correct Automobile lubrication

Explanation: In the schedule, the letter opposite the car indicates the grade of Gargoyle Mobiloil that should be used For example, "A" means "Gargoyle Mobiloil A." "Arc" means "Gargoyle Mobiloil Arctic." For all electric vehicles use Gargoyle Mobiloil "A." The recommendations cover both pleasure and commercial vehicles unless otherwise noted

MODEL OF	1910		1911		1912		1913		1914	
CARS	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Abbott Detroit	A	Arc.	A	Arc.	A	Arc	A	Arc.	Arc.	Arc.
Alco	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	...	...
American	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Autocar (2 cyl.)	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" (4 cyl.)	A	E	A	Arc.	A	Arc.	...	...	...	...
Avery	A	E	A	E	A	A	A	A	A	A
Buick (2 cyl.)	A	A	A	A	A	A	A	A	...	...
" (4 cyl.)	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc
Cadillac (4 cyl.)	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc
Cartercar	A	E	A	E	A	E	A	E	Arc.	Arc
" Com'l	A	E	A	Arc.	A	Arc.	A	Arc.	...	...
Case	...	...	A	A	A	Arc.	A	Arc.	A	Arc.
Chalmers	Arc.	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc	A	A
Chase	B	B	B	B	B	B	B	B	B	B
Cole	Arc.	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc	Arc.	Arc.
Delaunay-Belleville	B	A	B	A	B	A	B	A	B	A
E. M. F.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	...	...	...	...
Fiat	A	A	B	A	A	A	B	A	B	A
Flanders	E	E	E	E	Arc.	Arc.	...	...	...	...
" (6 cyl.)	...	...	...	...	...	...	Arc.	Arc.	...	...
Ford	A	Arc.	E	E	E	E	E	E	E	E
Franklin	E	Arc.	A	Arc.	A	Arc.	A	Arc.	A	A
" Com'l	B	A	B	A	A	Arc.	A	Arc.	...	...
G. M. C.	...	...	...	...	Arc.	Arc.	A	Arc.	A	Arc.
Havers 6-44	...	...	A	Arc.	A	Arc.	A	Arc	A	A
Havers 6-30	...	...	...	...	...	...	...	...	Arc.	Arc.
Haynes	A	E	A	Arc.	A	Arc	A	Arc.	A	Arc.
Hudson	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Hupmobile "20"	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	...	...
" "32"	...	...	...	...	...	...	A	Arc.	A	Arc.
I. H. C. (air)	...	...	...	...	...	...	B	A	B	A
" (water)	...	...	...	...	...	...	A	A	A	A
International	B	A	B	B	B	A	...	...	...	...
Interstate	A	E	A	Arc.	A	Arc.	A	Arc.	...	...
Jackson (2 cyl.)	A	A	...	...	...	...	...	...	...	...
" (4 cyl.)	A	Arc.	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
Jeffery	...	...	...	...	...	...	...	...	A	A
Kelly	...	...	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	A

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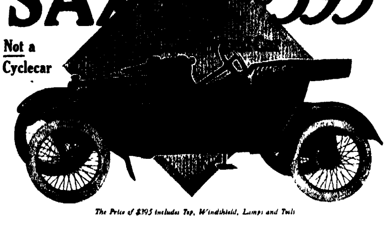
MODEL OF	1910		1911		1912		1913		1914	
CARS	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
King	...	...	A	E	A	E	A	E	A	A
Kline Kar	Arc.	Arc.	Arc.	Arc.	Arc.	Arc	Arc	Arc.	A	Arc.
Knox	B	A	B	A	B	A	B	A	B	A
Krit	A	A	A	A	A	A	A	A	A	A
Locomobile	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Lozier	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
Mack	A	E	A	E	E	E	E	E	A	A
Mack, Jr.	...	...	...	...	...	...	...	...	A	Arc.
Marion	A	E	A	E	A	Arc.	A	Arc.	...	...
Marmon	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Maxwell (2 cyl.)	E	E	E	E	E	E	...	...	...	...
" (4 cyl.)	E	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" (6 cyl.)	...	...	...	...	...	...	Arc.	Arc.	Arc.	Arc.
Mercer	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.

MODEL OF	1910		1911		1912		1913		1914	
CARS	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Mitchell	Arc	Arc	A	Arc	A	Arc.	A	Arc.	A	Arc
Moline	A	E	A	Arc	A	Arc	A	Arc	...	...
Moline Knight	...	...	...	...	...	...	...	...	A	A
Moon (4 cyl.)	A	E	Arc	Arc	Arc.	Arc	Arc	Arc.	A	Arc
Moon (6 cyl.)	...	...	...	...	...	...	...	...	Arc.	Arc.
National	A	A	A	A	A	A	A	A	A	A
Oakland	A	E	A	Arc	A	Arc	A	Arc	Arc	Arc
Oldsmobile	A	E	A	Arc	A	Arc	Arc	Arc	Arc	Arc.
Overland	A	E	Arc	Arc	Arc	Arc	Arc	Arc	Arc.	Arc
Packard	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Paige Detroit	E	E	A	Arc	A	E	A	E	A	A
Pathfinder	...	...	...	...	...	...	A	Arc	Arc	Arc
Peerless	Arc	Arc	Arc	Arc	Arc	Arc.	Arc	Arc.	Arc.	Arc.
Pierce Arrow	Arc	Arc	A	Arc	A	Arc.	Arc	Arc.	Arc	Arc.
" " Com'l			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Pope Hartford	Arc	Arc	Arc	Arc	Arc	Arc	Arc.	Arc	Arc	Arc
Premier	A	Arc.	A	Arc	A	Arc.	A	Arc.	A	Arc
Rambler	A	A	A	Arc	Arc.	Arc.	Arc.	Arc.	...	...
Regal	A	E	A	Arc.	Arc	Arc.	Arc.	Arc	Arc	Arc
Renault	A	Arc.	A	Arc	A	Arc.	A	Arc.	A	Arc
Reo	A	E	A	Arc.	A	Arc	A	Arc	A	Arc
S. G. V.	...	...	B	Arc	B	Arc.	B	Arc	A	Arc
Selden	A	B	A	E	Arc	Arc	Arc	Arc.	Arc	Arc
Simplex	Arc.	Arc.	Arc	Arc	Arc	Arc.	Arc.	Arc	Arc	Arc
Speedwell	Arc.	Arc.	A	Arc	A	Arc	Arc	Arc	Arc	Arc.
" "Mead"	...	...	...	...	...	...	A	Arc	B	A
Stearns	Arc.	Arc.	A	Arc	A	Arc				
" "Knight"	...				A	A	A	A	A	A
Stevens Duryea	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc.	Arc.
Stoddard-Dayton	Arc.	Arc.	A	A	A	A	A	A		...
" " "Knight"	...	...	...	...	A	A	A	A		
Studebaker	E	E	A	Arc	Arc	Arc	A	Arc	A	Arc
Stutz	...	...	...	...	A	A	A	A	A	A
Velie 9-45	A	E	A	Arc.	A	Arc.	A	Arc	A	Arc.
Velie 9-50	...	...	...	...	...	...			Arc.	Arc
Walter	A	E	Arc.	Arc	Arc.	Arc	Arc.	Arc	Arc.	Arc
White (Gas)	Arc.	Arc.	Arc.	Arc	Arc	Arc.	Arc.	Arc.	Arc.	Arc.
Winton	Arc.	Arc.	Arc	Arc	Arc.	Arc.	Arc	Arc	Arc.	Arc



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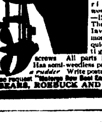

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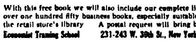

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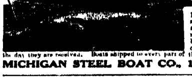

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The Taxicab Service of New York City

(Concluded from page 331.)

of Manhattan Borough whereof Times Square is the focal point. To utter the word "Taxi" in the vicinity of Times Square is to bring one of the gay-colored autocabs throbbing and pulsating before one at the curb.

The active season for taxicab service extends through about seventy-five per cent, or nine months of the year, but in that time the meters register the amazing total of 819,000 miles, almost four times the distance from the earth to the moon, which astronomers tell us is 221,000 miles in its nearest position. So Father Knickerbocker, seated in his fairly comfortable, if somewhat inelegant, taxicab, accomplishes yearly almost the equivalent of two round trips to the moon.

When the immensity of this mileage is taken into consideration, the physical capital which the industry in New York city alone represents and the earnings accomplished thereby seem relatively trifling. For $2,000 each would be a high valuation to place upon all of the taxicabs in service in the Greater City. Many vehicles are at the beck and call of patrons which have been condemned by the larger operating corporations and are valued in the open market at as low as $100; yet this average would mean a total valuation of no more than $6,000,000.

The most liberal estimate of the earnings of the taxicabs of New York would be $2,800 per year for the 75 per cent of the total number of machines operating throughout the year, and this would give an aggregate of gross earnings of $6,300,000.

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A SERIES of ten comprehensive articles on the present condition of our Navy, showing its unpreparedness, its present rating among the navies of the world, and what must be done to bring it up to its proper strength and position are being published consecutively in the SCIENTIFIC AMERICAN

Seven articles of this series have appeared in the issues of February 28th, March 7th, March 14th, March 21st, March 28th, April 4th, and April 11th, on the following subjects:

No. 1—"How the Navy is Daily Employed," by Hon. Franklin D. Roosevelt, Assistant Secretary of the Navy.

No. 2—"Sea Power and Our Foreign Policy."

No 3—"The Decline of the United States Navy to Third-Class Rank."

No 4—"The Price We Pay for Self-Sufficiency and Unpreparedness."

No. 5—"Battleship Strength Necessary to Guarantee Peace."

No 6—"The Shortage of Scouts, Torpedoes and Mines."

No. 7—"The Shortage of Officers and Men."

The eighth article appears in this issue.

No. 8—"The Need of a System of Rapid Mobilization"

Next week will be published:

No. 9—"The Need of a Council of National Defense."

The tenth and concluding article, written especially for this series, "The Navy is Not an Economic Waste," by Hon. Josephus Daniels, Secretary of the Navy.

Nelson's Tactics at Trafalgar are the subject of a recent report to the British Admiralty by a committee appointed to investigate the long-mooted question as to whether the plan of attack prepared by the great commander about a fortnight before the battle and communicated at that time to his captains was adhered to, or whether at the last moment a totally different plan was adopted, more or less by accident. The importance of this question consists in the fact that ultra-practical naval officers are prone to cite Nelson's alleged abandonment of his elaborate plan as an argument against naval tactics in general, claiming that in the heat of action tactics are forgotten. The report demonstrates beyond dispute that the plan drawn up on October 9th was carried out on October 21st in all essential respects.

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Inquiry No 9369. Wanted, the names and addresses of users of Indian Steatite (Soapstone), Corundum and other Indian minerals, in quantities.

Inquiry No. 9370. Wanted the names and addresses of manufacturers of small wooden articles, particularly in such soft woods as pine and fir, for articles such as toys, furniture, etc.

Inquiry No. 9371 Information wanted where one could buy or have made to order machine to be used for making solid back brushes.

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Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12977) E. M. B. asks: Are astronomers of the opinion that the telescope has attained its fullest scope? Do they think its power can be continually enlarged, so that after a while it may be possible to observe whether or not some nearby (relatively speaking) planet is inhabited? Or, as stated above, possibly the field of the telescope is limited, due perhaps to the molecular nature of glass (if glass can be said to be composed of molecules). A. The telescope is limited, but not because of the nature of glass. One limitation is in the Earth's atmosphere itself There are few nights when the highest powers can be used at all. The air is not sufficiently quiet and of uniform temperature. Other limitations are in the mechanical difficulties presented by large and heavy tubes, mounted to swing high in air, in the bending of large disks of glass suspended only by the edges, and the great increase in cost as the size is increased The disks of glass from which the 40-inch objective of the Yerkes telescope was made, weighed over a ton and cost $20,000. Many astronomers think that the limit in size of telescopes has already been reached.

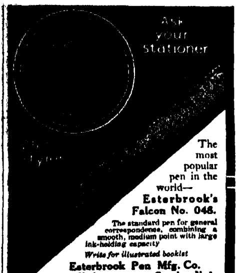
(12978) F J. C. asks: Will you please tell me what is, or about, the voltage given off by an ordinary jump spark coil when wired to a set of new batteries, say testing 6 volts and 20 amperes? A. The voltage required to send a spark through air between sharp points is about as follows For a half inch, about 12,000 volts; for one inch, about 20,000 volts, for 1½ inches, about 28,000 volts.

(12979) L. P. asks: I ask your opinion or interpretation of the following, which is said to have been taken from an old work said to have been written in Egypt: "Make a magnet of the plusquam-perfection accompanied by the *prime material* of which all *metals grow*, and with this the magnet of the compass can be strengthened." What is plusquam-perfection (if anything) and what is the prime material of which all metals grow? A. The word "plusquam" is a Latin word, and means "more than." Applied to a magnet it should mean a supersaturated magnet, which will not retain all its magnetism. We doubt if the Egyptians knew anything about such magnets. There is no "prime material" from which all metals grow. *That is an old notion of the alchemists.* When the compass needle has been saturated, any further magnetizing is of no account. The needle will drop back to its ordinary strength as soon as the extra force is taken away from its vicinity.

(12980) S. A. W. asks: I want information concerning what I believe is called "Fermat's theorem." It is

$$x^{2+n} + y^{2+n} = z^{2+n}$$

when n is a positive integer About a year ago, I read in the SCIENTIFIC AMERICAN that a large prize had been offered for a solution I have a partial proof which I wish to submit A A prize of 100,000 marks (about $25,000) is offered by the *Academy of Sciences of Goettingen for the proof* of the greater Fermat theorem Fermat stated that the equation $x^n + y^n = z^n$ could not be satisfied by whole numbers when n is an odd prime number. This is the theorem to be proved to win the prize. We receive so many inquiries about this very attractive offer that we will state the conditions made by the Academy of Sciences for winning the prize It will not consider any manuscripts sent to it in competition for the prize, but will consider all memoirs which appear in the mathematical periodicals, or which are for sale in the book trade as monographs or as books The Academy requests the authors of such memoirs to send it five printed copies Memoirs in languages unknown to the judges must be accompanied by authentic translations. The award will not be made earlier than two years after the publication of the memoir for which it is awarded. The award cannot be contested During the two years, opportunity will be given to mathematicians to express an opinion upon the correctness of the solution selected, which will be made public. These are the principal regulations for the award. It is evident that only a complete mathematical solution may be offered. No partial solution will be considered. No one can send in a manuscript for the contest. A printed copy only will be received, published by some book house or in a mathematical periodical, which means that the solution must commend itself to some competent editor, or to a publisher as likely to be a profitable investment, in the first place. It must then meet the criticism of the mathematical world for two years after the Academy has approved of it. The Academy does not intend to be flooded with manuscripts which have not been endorsed by any one of prominence in the mathematical world. We trust that all our correspondents will note these points. They are abstracted from the offer of the prize in the *Bulletin* of the American Mathematical Society, October, 1908, pages 44–45. Also in the same periodical for November, 1907, page 92. We are indebted for this information to Dr. Joseph Bowden, Professor of Mathematics, Adelphi College, Brooklyn, N. Y.



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THE telephone instrument is a common sight, but it affords no idea of the magnitude of the mechanical equipment by which it is made effective.

To give you some conception of the great number of persons and the enormous quantity of materials required to maintain an always-efficient service, various comparisons are here presented.

The cost of these materials unassembled is only 45% of the cost of constructing the telephone plant.

Poles
enough to build a stockade around California—12,400,000 of them, worth in the lumber yard about $40,000,000.

Telephones
enough to string around Lake Erie—8,000,000 of them. 5,000,000 Bell owned, which, with equipment, cost at the factory $45,000,000.

Wire
to coil around the earth 621 times — 15,460,000 miles of it, worth about $100,000,000, including 260,000 tons of copper, worth $88,000,000.

Switchboards
in a line would extend thirty-six miles — 55,000 of them, which cost, unassembled, $90,000,000.

Lead and Tin
to load 6,600 coal cars — being 659,960,000 pounds, worth more than $37,000,000.

Buildings
sufficient to house a city of 150,000—more than a thousand buildings, which, unfurnished, and without land, cost $44,000,000.

Conduits
to go five times through the earth from pole to pole—225,778,000 feet, worth in the warehouse $9,000,000.

People
equal in numbers to the entire population of Wyoming—150,000 Bell System employees, not including those of connecting companies.

The poles are set all over this country, and strung with wires and cables; the conduits are buried under the great cities; the telephones are installed in separate homes and offices; the switchboards housed, connected and supplemented with other machinery, and the whole Bell System kept in running order so that each subscriber may talk at any time, anywhere.

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NEW BOOKS, ETC.

The Cause of the Social Evil and the Remedy. By Albert W. Elliott, President and General Manager the Southern Rescue Mission. Atlanta, Ga.: Webb & Vary Company, 1914. 16mo.; 144 pp.

In so far as this book deals with actual conditions and personal observations it is well worth a careful reading. The author's experiences have led him from the belief that the remedy lies in legal suppression, or even in reformation, through a dawning conviction that social vice is more a matter of the well-to-do and "respectable" classes than a mere problem of the underworld; until at length he sees that the fundamental causes must be sought elsewhere than in economic conditions. The weakest portion of the work is that dealing with "the remedy." The author himself seems to realize his helplessness here, for he is converted to the theory of toleration, though not of license, and he leaves the problem substantially as he finds it

Electric Light and Motor Wiring. By George J. Kirchgasser. Milwaukee, Wis.: Electroforce Publishing Company, 1914. Price, $1.

This is a book small enough to fit into the vest pocket, yet containing a great deal of up-to-date information on ordinary wiring. The National Electric Code requirements are cited, different systems are described in detail, and the illustrations and diagrams average at least one to a page

The Origin of Earthquakes. By Charles Davison, Sc.D., F.G.S. Cambridge: The University Press. New York: G. P. Putnam's Sons.

In a small compass, the author has explained earthquake phenomena, earthquakes and the growth of faults, discussed some simple earthquakes and their origin, as well as twin earthquakes and their origin, complex earthquakes and their origin, illuminated the subject of fore and after shocks, discussed sympathetic earthquakes and their origin, as well as earthquake sounds and their origin, and thus given the reader interested in popular science a good *résumé* of modern seismology.

Links with the Past in the Plant World. By A. C. Seward, M.A., F.R.S., Professor of Botany in the University of Cambridge. Cambridge: The University Press. New York: G. P. Putnam's Sons.

In this book, the reader who seeks only the facts of an important science presented in a popular way will find a very readable account of the botany of the present compared with the botany of the past. The subject is one which is fascinating, one which has a wide popular appeal. It lends itself admirably to presentation in simple form Prof Seward has made the most of his opportunities

The Migration of Birds. By T. A. Coward. Cambridge· The University Press. New York: G. P. Putnam's Sons.

In this popular book will be found the more important theories on the migration of birds and a discussion of speculations and evidence. The subject is a controversial one Almost every student of bird flight has his own views. While, therefore, it is very difficult to write impartially, we believe that Mr. Coward has acquitted himself very creditably

An Introduction to Experimental Psychology. By Charles S. Myers, M.D., Sc.D., Lecturer in Experimental Psychology at the University of Cambridge. Cambridge: The University Press. New York: G. P. Putnam's Sons.

The author has selected various topics which may be considered fairly typical themes of research in experimental psychology, such, for example, as color-vision, touch, temperature, the Mueller-Lyer illusion, experimental aesthetics, memory, mental tests and their uses; and these he has presented in such a form as will give the educated reader a general notion of the scope of the science and of the experimental methods it employs

The Natural History of Clay. By Alfred D. Searle. Cambridge: The University Press. New York: G. P. Putnam's Sons.

Mr. Searle has stated, in a simple form, an outline of present knowledge of the subject of clay, and has indicated the problems which still lie before the clay worker First he discusses the chemical and physical properties of clay and then passes on to clay and associate rocks, the origin of clays, the modes of accumulation of clays, some clays of commercial importance, and clay substances; theoretical and actual. A good bibliography and index concludes the book.

The Wanderings of Peoples. By A. C. Haddon, Sc.D., F.R.S., Cambridge: The University Press. New York: G. P. Putnam's Sons.

This book is a brief survey, written in popular language, of the trend of human migrations so far as present knowledge permits. The author has covered various periods of human history, even going as far back as the earliest diffusions that can be predicated.

The Work of Rain and Rivers. By T. G. Bonney, F.R.S. Cambridge: The University Press. New York: G. P. Putnam's Sons.

In this book, persons of ordinary education will find all that they need to know of this interesting subject. The use of technical terms has been avoided, as well as the discussion of controversial points.

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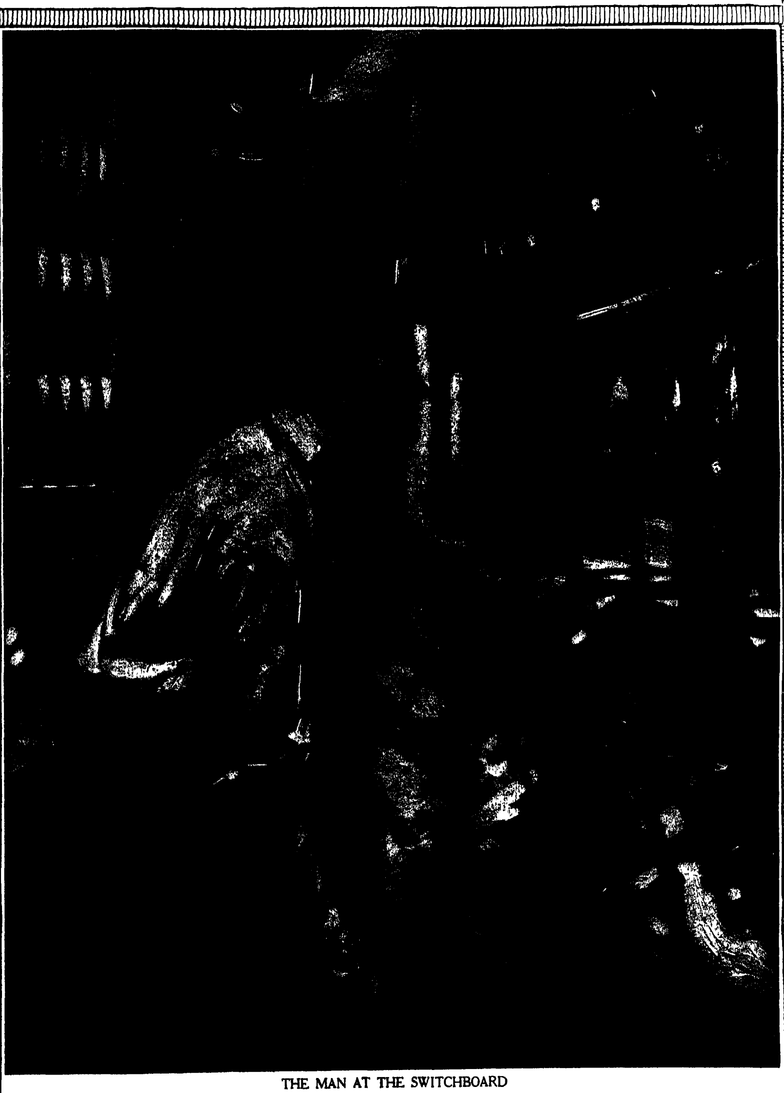

THE MAN AT THE SWITCHBOARD

Vol. CX. No. 17
April 25, 1914

Munn & Co., Inc., Publishers
New York, N. Y.

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Fuel and Repairs

You can lower these expenses

In three years' time supplies and repairs occasionally cost as much as the original price of a car.

Careless lubrication is responsible for most of this expense.

A canvass among New York repair shops showed that about one-half of the automobile engine troubles are caused by incorrect lubrication.

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Low *quality* oil in time may bring practically every trouble a motor can face.

Oil of a *body* which is incorrect for *your* motor brings many penalties--heating and seizing of bearings, worn wrist pins, poor compression, breaking of parts, excess carbon deposit, smoking or overheating of engine and many other troubles.

Aside from repair troubles you must face a plain fact.

The more power you waste the more fuel you must consume

You cannot get perfect lubrication unless the *quality* is right, and the *body* of your oil suits—

(1) Your type of lubrication system.
(2) Your piston clearance.
(3) Your bearing design and adjustment.
(4) Your bore and stroke
(5) Your engine speed
(6) The size and location of valves.
(7) Your cooling system.

Gargoyle Mobiloils are sold *by a Chart* which specifies the correct grade for each car.

They are backed by almost 50 years' experience which has won for us the world-leadership in scientific lubrication

If you do not at present use the grade of Gargoyle Mobiloils specified for your car, you may feel almost certain that your bills for fuel and repairs are higher than they should be

Consult the partial Chart printed at the right. Make a note of the grade specified for your car. Then make certain that you get it. If your car is not mentioned send for our complete Chart of Recommendations.

It is safest to buy in original barrels, half-barrels and sealed five and one-gallon cans See that the red Gargoyle our mark of manufacture, is on the container

On request we will mail a pamphlet on the Lubrication of Automobile Engines It describes in detail the common engine troubles and gives their causes and remedies.

Correct Lubrication

Explanation: In the schedule, the letter opposite the car indicates the grade of Gargoyle Mobiloil that should be used For example "A" means "Gargoyle Mobiloil A." "Arc." means "Gargoyle Mobiloil Arctic." For all electric vehicles use Gargoyle Mobiloil "A." The recommendations cover both pleasure and commercial vehicles unless otherwise noted.

MODEL OF	1910		1911		1912		1913		1914	
CARS	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Abbott Detroit	A	Arc	A	Arc	A	Arc	A	Arc.	Arc.	Arc
Alco	Arc.	Arc.	Arc	Arc	Arc	Arc	Arc	Arc		
American	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc.
Autocar (2 cyl.)	A	Arc.	A	Arc	A	Arc.	A	Arc.	A	Arc.
" (4 cyl.)	A	E	A	Arc	A	Arc				
Avery	A	E	A	E	A	A	A	A	A	A
Buick (2 cyl.)	A	A	A	A	A	A	A	A		
" (4 cyl.)	Arc	Arc.	A	Arc	A	Arc	A	Arc.	A	Arc.
Cadillac (4 cyl.)	Arc.	Arc	Arc	Arc	Arc	Arc	Arc.	Arc	Arc	Arc.
Cartercar	A	E	A	E	A	E	A	E	Arc.	Arc.
" Com'l.	A	E	A	Arc	A	Arc	A	Arc.		
Case			A	A	A	Arc	A	Arc	A	Arc.
Chalmers.	Arc	Arc	A	Arc	Arc	Arc	Arc.	Arc	A	A
Chase	B	B	B	B	B	B	B	B	B	B
Cole	Arc	Arc	A	Arc	Arc	Arc.	Arc	Arc	Arc.	Arc.
Delaunay-Belleville	B	A	B	A	B	A	B	A	B	A
E M F	Arc	Arc	Arc.	Arc	Arc.	Arc				
Fiat	A	A	B	A	A	A	B	A	B	A
Flanders	E	E	E	E	Arc.	Arc				
" (6 cyl.)							Arc	Arc		
Ford	A	Arc	E	E	E	E	E	E	E	E
Franklin	B	Arc	A	Arc.	A	Arc	A	Arc.	A	A
" Com'l.	B	A	B	A	A	Arc.	A	Arc.		
G M C					Arc	Arc.	A	Arc	A	Arc.
Havers 6-44			A	Arc.	A	Arc	A	Arc.	A	A
Havers 6-60.									Arc	Arc.
Haynes	A	E	A	Arc	A	Arc.	A	Arc.	A	Arc.
Hudson	Arc.	Arc.	A	Arc	A	Arc	A	Arc	A	Arc.
Hupmobile "20"	Arc	Arc	Arc	Arc	Arc.	Arc.	Arc	Arc		
" "32"							A	Arc	A	Arc.
I H C (air)							B	A	B	A
" (water)							A	A	A	A
International	E	A	B	B	B	A				
Interstate	A	E	A	Arc	A	Arc	A	Arc		
Jackson (2 cyl.)	A	A								
" (4 cyl.)	A	Arc	A	Arc	A	Arc.	A	Arc.	Arc.	Arc.
Jeffery									A	A
Kelly			Arc	Arc.	Arc	Arc	Arc	Arc.	A	A
King			A	E	A	E	A	E	A	A
Kline Kar	Arc	Arc.	Arc	Arc	Arc	Arc	Arc.	Arc	A	Arc.
Knox.	B	A	B	A	B	A	B	A	B	A
Krit	A	A	A	A	A	A	A	A	A	A
Locomobile	Arc.	Arc.	Arc	Arc.	Arc	Arc	Arc	Arc	Arc	Arc
Lozier	Arc	Arc	Arc	Arc.	Arc	Arc.	Arc.	Arc	A	Arc.
Mack	A	E	A	E	E	E	E	E	A	A
Mack, Jr									A	Arc
Marion.	A	E	A	E	A	Arc	A	Arc		
Marmon	A	E	A	Arc	A	Arc	A	Arc.	A	Arc.
Maxwell (2 cyl.)	E	E	E	E	E	E				
" (4 cyl.)	E	E	Arc	Arc.	Arc.	Arc	Arc	Arc	Arc	Arc
" (6 cyl.)							Arc.	Arc.	Arc.	Arc.
Mercer	A	Arc	A	Arc.	A	Arc	A	Arc	A	Arc.
Mitchell	Arc	Arc.	A	Arc	A	Arc.	A	Arc.	A	Arc
Moline	A	E	A	Arc	A	Arc.	A	Arc.		
Moline Knight									A	A
Moon (4 cyl.)	A	E	Arc.	Arc	Arc.	Arc	Arc.	Arc	A	Arc.
Moon (6 cyl.)									Arc.	Arc.
National	A	A	A	A	A	A	A	A	A	A
Oakland	A	E	A	Arc.	A	Arc.	A	Arc.	Arc	Arc.
Oldsmobile	A	E	A	Arc	A	Arc.	Arc	Arc	Arc	Arc.
Overland	A	E	Arc.	Arc	Arc.	Arc.	Arc	Arc.	Arc.	Arc.
Packard	Arc.	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc.
Paige Detroit	E	E	A	Arc	A	E	A	E	A	A
Pathfinder							A	Arc.	Arc.	Arc.
Peerless	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Pierce Arrow	Arc	Arc	A	Arc.	A	Arc.	Arc	Arc	Arc.	Arc
" " Com'l			Arc	Arc	Arc	Arc.	Arc	Arc	Arc.	Arc
Pope Hartford	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc.
Premier	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc.
Rambler	A	A	A	Arc	Arc	Arc.	Arc.	Arc		
Regal	A	E	A	Arc	Arc	Arc	Arc	Arc	Arc.	Arc.
Renault	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc.
Reo	A	E	A	Arc	A	Arc	A	Arc	A	Arc
S G V			B	Arc	B	Arc	B	Arc	A	Arc
Selden	A	E	A	E	Arc.	Arc	Arc	Arc.	Arc	Arc.
Simplex	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc.	Arc	Arc.
Speedwell	Arc	Arc	A	Arc	A	Arc	Arc	Arc.	Arc	Arc.
" "Mead"							A	Arc	B	A
Stearns	Arc	Arc	A	Arc	A	Arc				
" "Knight"					A	A	A	A	A	A
Stevens Duryea	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc.
Stoddard Dayton	Arc	Arc	A	A	A	A	A	A		
" "Knight"					A	A	A	A		
Studebaker	E	E	A	Arc	Arc	Arc	A	Arc	A	Arc.
Stutz					A	A	A	A	A	A
Velie 9-45	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Velie 9-50.									Arc.	Arc.
Walter	A	E	Arc	Arc	Arc	Arc	Arc	Arc	Arc.	Arc.
White (Gas)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc.	Arc.
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc.	Arc.

The various grades of Gargoyle Mobiloils, purified to remove free carbon, are·

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Gargoyle Mobiloil "B,"
Gargoyle Mobiloil "E,"
Gargoyle Mobiloil "Arctic."

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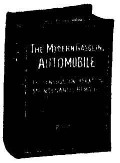

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April 11, No 7—"The Shortage of Officers and Men."

April 18, No 8—"The Need of a System of Rapid Mobilization."

April 25, The 9th article appears in this issue—"The Need of a Council of National Defense"

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"Making The Navy An Economic Asset"

By HON. JOSEPHUS DANIELS, Secretary of the Navy

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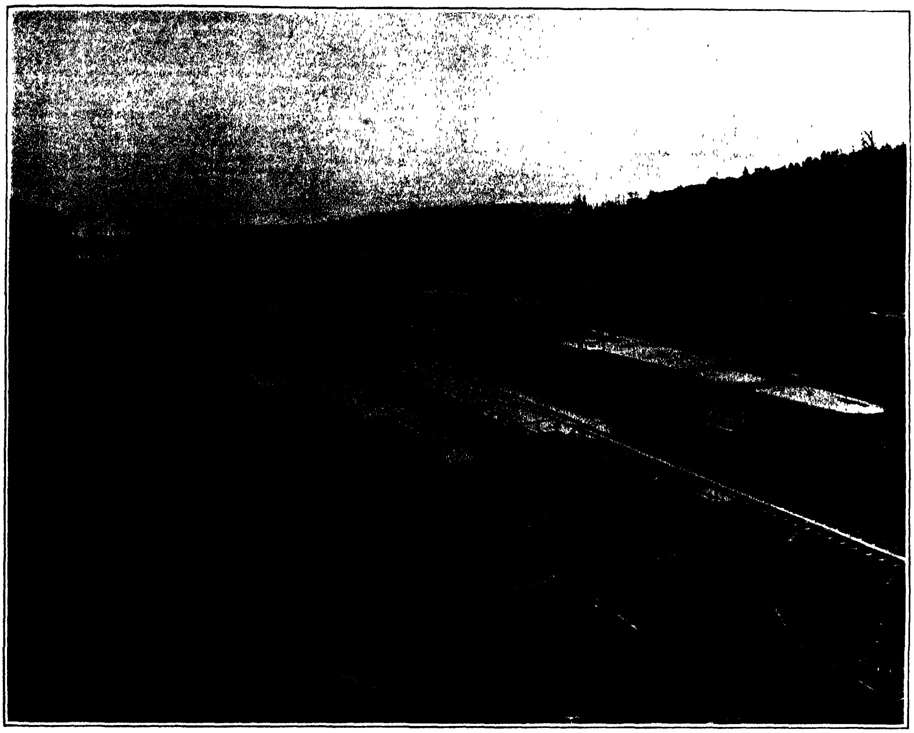

Length, 825 feet; width, 80 feet, inside height, 56 feet Estimated cost, $3,275,000 for the locks and canal

Lake Washington *canal* lock.

The Lake Washington Canal Locks

AN important work now nearing completion is the great locks of the Government canal at Salmon Bay, by means of which shipping will be able to pass from Puget Sound at Seattle to Lakes Washington and Union. The works are so far advanced that the first ship is expected to pass through the waterway early in 1915.

The public mind has been so filled with the story of the construction of the Panama Canal and its great locks at Gatun and elsewhere, that it is apt to overlook the fact that several other works of this character of great magnitude are also being carried out. The Lake Washington canal and locks are a case in point. The lock is 825 feet long, 80 feet wide on the inside and 56 feet high. The walls of concrete are 53 feet in thickness at the bottom and 8 feet at the top. This structure is known as the Big Lock. The Small Lock is 30 feet wide and 160 feet long. The latter is being built for the use of small boats, and, of course, it will result in the saving of much expense, since a large part of the traffic is of such size as not to call for the use of the greater structure.

When the locks are finished the level of Lake Union will be raised to twenty-one feet above the high water mark, and both this lake and Lake Washington with the factories along their shores, of which there are many to-day with the prospect of a great many more in the future, will be in direct water communication with the Pacific. One great advantage of the new works is that since the water in the lakes is fresh, ships will be able to pass through the locks and relieve themselves of barnacles and other marine growths which will drop off from their bottoms, leaving them clean for the next voyage. Also, the canals will have a distinct value to the Navy, whose ships of the medium and smaller sizes - all ships, in fact, except the larger dreadnoughts—will be able to enter the fresh water lakes if emergency or other causes should render it desirable

The first estimate for this work was $2,275,000 for the locks, $1,000,000 for the dredging. The cost of the locks is being paid by the United States Government and that of the canal by the city and county

General Gorgas Honored in England

ON March 23rd, Surgeon-General Gorgas, of the United States Army, lectured in London before the Royal Society of Medicine on his sanitary work in Panama. In the course of his lecture he modestly admitted that if the Americans had known no more in 1904 about the mode or transmission of malaria and yellow fever than was known in 1880, when the French tried to solve the problem of sanitation on the Isthmus, they probably could not have done any better than did the latter. The same night General Gorgas was entertained by the medical profession at dinner at the Savoy Hotel, and on the 24th he received the degree of Doctor of Science, *honoris causa*, at a special convocation held at Oxford University, for his work in rendering the construction of the Panam Canal possible by stamping out yellow and malarial fevers The London *Times* editorially refers to Gen Gorgas as "indisputably the *foremost sanitary officer in the world*," and *one* who "has perhaps done more than any other man to throw *open the tropics, or to show how they can be thrown* open, to habitation by Caucasians."

Motor Omnibus Service for Bolivia. At first blush, the *mountainous portion* of Bolivia would not appear just the place for the establishment of a motor 'bus service. Yet one is to be established there. Four six-cylinder 'buses have been purchased by a syndicate to replace mule-drawn coaches which heretofore have been used. The route is approximately 100 miles in length, and the 'buses must always be operated at an altitude of 7,000 feet or more. The service will link the cities of Potosi and Sucre, which latter is the capital of Bolivia. Leaving the former city, there is a climb of five kilometers where the highest pass in the Andes (14,000 feet elevation) is crossed. The average grade is about 17 per cent. Three of the 'buses will carry 11 passengers each, in addition to a certain amount of freight The fourth is a *de luxe* extra fare car with heavily upholstered seats and accommodations for only seven passengers. All of the cars are electrically lighted and started They will be operated on a regular schedule, making the trip one way in 12 hours.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the *facts authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement

Highway Problem in New York State

THE State of New York is engaged in building twelve thousand miles of road, which, according to Governor Glynn, will wear out forty years *before it is paid for. That is an astounding statement*, and unfortunately it is not more astounding than it is true. This fact and many others of an illuminating and extremely disconcerting character were contained in a recent message of the Governor to the Legislature. The message is written in the direct and unadorned style which characterizes the Governor's utterances, and it contains an array of facts of such great importance to the people of this State, that we could wish to see a copy of this message placed in the hands of every voter throughout the State.

The question of the proper construction and maintenance of roads is not a new one in the columns of this journal. For many years, and during the whole period in which the country, awakened to the sense of its need, has been giving attention to the matter of highway construction, the SCIENTIFIC AMERICAN has emphasized the fact that the problem is more one of maintenance than of construction. The various States have built new macadam roads upon the most approved modern principles, and these roads, at least in late years, have been as good as any that could be constructed. Unfortunately the State authorities have been slow to realize that, of all civil engineering constructions, the macadam road is the one of all others that needs incessant supervision, and immediate and most careful repair whenever and wherever the signs of breaking down and general disintegration are seen.

The macadam road is admirably adapted for the class of highway traffic which passed over it in the period preceding the appearance of the automobile and the motor truck. For horse-drawn traffic it is ideal, and, with a reasonable amount of supervision and repair, it may be regarded as a permanent structure. To-day, however, such are the speeds and weights of the automobile and motor truck, and so greatly have they multiplied in numbers, that the macadam road has proved unequal to the burden laid upon it; for even where the materials are available for treating its surface, the cost of maintenance has reached a figure which renders it an uneconomical construction and invites a search for some other type of road, which will cost no more, or but very little more, to construct, and whose annual repairs bills will be reasonable.

The brick road offers such a substitute. Its first cost is not prohibitive, it is very durable; and the annual cost of repairs under a careful supervision is almost negligible. A substitute whose first cost is less than that of the brick road, but regarding whose cost of upkeep there is less data available, is the concrete road.

Now a first-class macadam road costs in this State from $10,000 to $13,000 a mile to build; a concrete road costs from $12,000 to $16,000 a mile, and a brick road costs from $20,000 to $25,000 a mile. Thus far the experience of the modern road builder with concrete has been limited. Michigan has roads of this character in one county, and the results have been very satisfactory; but the roads have not been in service long enough to justify any conclusion as to their permanence and economy. In hundreds of cities brick roads have been laid and have been down for many years, which, without exception, have demonstrated their durability. Roads of this character, which have been in service for twenty-five years, have stood up under the test of the hardest kind of traffic. What is more to the point is that the annual cost of maintaining these brick roads has been remarkably low, ranging from practically nothing to from $10 to $50 per mile.

Now in New York a mile of macadam costing $12,000 would not last over ten years, and it costs $1,000 a year to maintain and surface such a road. At the end of the ten years the roads must be rebuilt, and the cost of the reconstruction would be $6,000 a mile. The total expenditure for twenty years on a macadam road amounts to $36,000, including $12,000 for building, $18,000 for maintenance, and $6,000 for rebuilding at the end of the first ten years.

Compare this with the total expenditures for ten years on a vitrified brick road, which will amount to $26,000 only, if we allow a maximum of $25,000 a year for building and a maximum figure of $50 a year for maintenance.

Governor Glynn advocates the use of vitrified brick rather than concrete because the State geologist informs him that New York State has an inexhaustible and widely distributed deposit of shale, which may be made the basis of a brick industry large enough to supply all the local requirements with materials of the best quality. The Governor advocates the use of prison labor in making the bricks, leaving the State roads to be constructed by free labor working under contractors or in the employ of the State itself. It is estimated that by this plan brick roads can be constructed at a cost of $15,000 per mile. Now on this basis the total cost of a mile of brick road for twenty years would be $16,000, including $15,000 for the original construction and twenty years of maintenance at $50 a year. The total cost of a macadam road for the same period, as we have shown above, is over double this sum, or $36,000. It is pointed out that the magnitude in the economy thus proposed is shown by the fact that the total saving in 7,300 miles of road yet to be constructed will amount to $146,000,000 in the twenty years after their completion, or more than the total cost of constructing the State's entire system of highways.

That some very radical change must be made in the present plans for the construction of our State highways is shown by the following facts: One hundred million dollars has been voted for the construction of the new highways in New York State. If the future roads cost as much as those which have been built, it will require an additional thirty million to complete *the whole system*. On New York's 12,000 miles of macadam road, the annual cost of maintenance will be $12,000,000. The total cost of the roads will be $130,000,000, and at the end of the ten years, which under heavy automobile and motor traffic is the term of life of a macadam road, the State will have little to show for its expenditure of $250,000,000. Furthermore, in twenty years thereafter the tax for highways will be at least $20,000,000 each year, if the roads are to be kept in proper condition.

"Every year," says Governor Glynn, "the taxpayers of New York will be compelled to pay $20,000,000 for *maintenance*. Every year they will be forced to pay $5,000,000 in interest charges on their bonds. Every year they will be compelled to contribute $2,500,000 to the Sinking Fund to take up the bonds when they mature; and every year they will be required to pay additional millions to rebuild part of the roads on which they are lavishing these tremendous sums. In other words, New York must either change its road policy or prepare to levy a perpetual and yearly road tax of $2 on every man, woman and child within its borders."

The Medical Congress and Our Sewage Scandal

WHAT expressions of disgust and horror were voiced by the distinguished foreign medical men as they sailed into the harbor of this city last week, we have not been informed. But surely they could not have failed to observe that Manhattan is an island surrounded on all sides by sewage. Deluded by the notion that the North, the Harlem, and the East Rivers were really flowing rivers of salt water, and that salt water has an unlimited capacity for digesting sewage, we have been pouring into these bodies of water the excreta of the city for years, without the least concern, until matters have become so serious that it has actually been necessary to dredge out the docks to remove accumulations of sludge.

It requires no critical analysis to reveal the foul conditions of the harbor. The floating refuse is all too evident to the casual observer from the steamship decks, and it must remain a disgrace to the city until adequate methods of sewage disposal are adopted. Fortunately steps in this direction have already been taken. During the administration of Mayor Gaynor a commission of five experts on sewage disposal and engineering was appointed to investigate conditions and to propose remedial measures. After a careful study of the matter, a plan was outlined which we explained in the columns of the SCIENTIFIC AMERICAN about a year ago. It consisted in establishing treatment plants on islands in the East River, and on an artificial island in the lower bay where most of the sewage could be treated to have the solids removed and taken away by tank steamers, while the liquids could be discharged into the surrounding waters after being rendered innocuous. The most spectacular feature of the report was the plan for a tunnel from Manhattan under Brooklyn to an artificial island in the lower bay, and this was dwelt upon to such an extent by the papers as to be considered the chief station of sewage treatment, whereas the plans called for the treatment of twice as much at Ward's Island. Unfortunately, because of its spectacular nature, the plan for an artificial island came to be looked upon as not feasible, even though it involved no departure from well-known engineering practice, and was thoroughly endorsed by competent engineers in addition to the engineers of the Commission. Realizing this, the Commission found it necessary to modify its plans.

A policy of progressive construction is now recommended. It is urged that intercepting sewers be built along the shores of the East River on both sides and that they be led to filter stations, where the sludge will be removed from the sewage and the liquid matter discharged into the river. The sludge would have to be hauled away in tank steamers. This would involve an immediate expenditure of $4,000,000. But it would represent part of the ultimate system as originally outlined by the Commission. When the city was ready to extend the system farther, a tunnel would be run under the river connecting the two intercepting mains, a pumping plant would be built on the Brooklyn side and a tunnel would be run from there through rock to the artificial island in the lower bay. This would involve an expenditure of $18,000,000 more, according to present estimates, while the work already done would fit into the system without requiring any reconstruction or waste of the original outlay. But before this extension was built, the plant at Ward's Island would be installed to relieve conditions in the upper part of the city.

In the mean time possibly some plan may be evolved for utilizing the sludge. The matter has been given serious consideration, but so far no method has been brought forth for utilizing the material, and apparently nothing can be done but to haul it away in tank steamers. Here it seems is a problem for the inventor to solve.

We are pleased to note that the new administration shows an eagerness to take up this pressing problem of sewage disposal. The Mayor and the Board of Estimate are investigating the report of the Commission, and the matter is to be considered further at a second meeting next month. We realize that matters of such great importance must be taken up with due deliberation. But the problem has already received exhaustive study at the hands of a commission of competent engineers, and we cannot but urge that their plans be pursued with all speed.

The Problem of Our Navy

THE series of articles on "The Problem of Our Navy," which has been running consecutively for the past two months in this journal, is now drawing to a close. We cannot forbear drawing attention to the fact that the serious crisis which has developed over night in the Gulf of Mexico is a striking illustration of the necessity of this country's possessing a navy whose ships are prepared to respond instantly to the call of the President, and proceed to any point where it is necessary to make a demonstration of the power of the United States and of its determination to secure for its flag due respect and for its citizens, whether military or civilian, proper treatment.

The last article of the Naval series, written by the Secretary of the Navy, which will appear in our next issue, will deal with an important element of the navy problem under the title: "How to Make the Navy an Economic Asset."

Biological Effects of Blue-violet Rays

THE ordinary data of physical climatology are of limited value when applied to the solution of biological problems. Thus air-temperature is well known to be of much less significance in this connection than direct solar radiation. Moreover, recent studies make it evident that gross solar radiation is less important, biologically, than radiation of particular wave-lengths, especially the blue-violet. H. A. Spoehr has been making comparisons at Tucson, Arizona, between the measurements of solar radiation as a whole, obtained by means of the Smithsonian pyrheliometer, and measurements of blue-violet radiation with an oxalic acid photometer. He finds that the intensity of the latter shows sudden and unpredictable variations quite independent of the variations in total intensity. Winter values are decidedly less than those of summer, while the afternoon is generally weaker than the morning. Reflection from cumulus clouds appears to increase the values.

Engineering

England Prefers Hydraulic Gun-Operating Gear.—Some years ago Great Britain, which has used exclusively hydraulic operating gear for her guns and turrets, made an extensive trial of electrical gear on the battle-cruiser "Invincible." Two different electrical systems were fitted in the barbettes which carried the eight 12-inch guns. It is stated that none of the systems has come up to expectations, and they are now being removed to make way for hydraulic installations.

The Merchant Tonnage of the World.—The latest figures showing the tonnage of the merchant fleets of the principal maritime powers, prove that Great Britain still holds her commanding lead, with a tonnage nearly one third greater than that of all the other maritime powers combined. Thus Great Britain possesses 20,275,791 tons; Germany, 4,998,746; United States, 3,489,736 tons, the greater part of which is domestic shipping; Norway, 2,475,328 tons; France, 2,246,504 tons; Japan, 1,709,062 tons; and Italy, 1,571,761 tons.

The Increasing Size and Speed of Submarines.—The day is approaching when seagoing submarines of high surface-speed will accompany the main fleet on the high seas. Large vessels of this type, of 21 knots speed, have been designed for our Navy. Great Britain is building, in the "Nautilus," the largest submarine in existence, which is intended to be as seaworthy while on the surface as the latest type of destroyer. Its surface speed will be not less than 21 knots and it will have a submerged speed of from 15 to 16 knots; it will carry six torpedo tubes, and the surface displacement will be about 1,500 tons.

A French Sixteen-Gun Dreadnought.—The French naval authorities are so well pleased with their four-gun turrets, that their latest class of dreadnoughts is to be fitted with four of these turrets, carrying among them a broadside of no less than sixteen 13.4-inch guns. These ships will be able to concentrate eight guns ahead and astern, so that in point of numbers their all-round fire will exceed that of our own "Pennsylvania," which can fire six 14-inch guns ahead and astern, and twelve on the broadside. The British in the "Queen Elizabeth" have decreased the number and increased the power of the guns, these ships carrying each eight 15-inch guns.

The Navy and Columbia University.—The Secretary of the Navy has expressed his gratification and pleasure in noting the co-ordination in the Post-Graduate Department of the United States Naval Academy at Columbia University, and the advance made by young naval officers under instructions in the lecture rooms and laboratories of that university. Eighteen officers are taking the course at Columbia, in which the theories of thermodynamics, machine design, electricity and radio-telegraphy are adapted for practical application in the naval service, and in which special subjects and problems that are encountered on board ship are worked out.

Steam Shovel Work Completed in Culebra Cut.—The dry excavation in Culebra Cut was terminated on March 31st, when the three 95-ton steam shovels that were engaged in lessening the pressure on the east Culebra slide north of Gold Hill, were withdrawn and made ready for dismantling. When the steam shovel work was completed on the bottom of the cut in September, 1913, no less than thirteen steam shovels were engaged on high levels at various points of the cut. That number has been gradually reduced. At the end of November six were in service; at the end of December, four. Two more were removed late in February, and now the finishing up at Culebra is being accomplished by dredges.

Canal to Open About July 1st.—Col. Goethals has announced that, unless unforeseen developments occur at the Cucuracha slide, and this is not likely, the canal will be opened to commercial vessels about July 1st of this year. The dredges are working on the channel which has been cut through the slide, and the present effort is to make the channel so broad that these dredges will not interfere with the passing of ships. Incidentally, it may be mentioned that Col. Goethals is opposed to the exemption of tolls "because," as he has said, "I want all the money we can get out of the operation of the canal." He further stated that the fortifications on the Atlantic side of the canal are about completed, and those on the Pacific side about two thirds finished.

Oil Cooking in the Navy.—In agreement with the Navy Department policy of using oil instead of coal, there have been installed on the "Pennsylvania" and on Battleship 39, oil ranges for cooking purposes. In the matter of first cost there is a saving by the use of oil for cooking of about $8,500 for each ship and in operation the economy is much more marked. The question of the economy of operation in the galley is quite important. Thus the batch of bread alone baked each day for the crew of a modern dreadnought calls for the use of about six barrels of flour. The relative costs of cooking by the different methods have been found to be as follows per day: Electric range, $22.50; coal range, $16.00; oil range, $5.65. When in addition to the economy, the cleanliness and absence of ashes is considered, the advantage of cooking by oil on a ship which burns oil only in its main boilers is readily apparent.

Electricity

Submarine Power Cable.—The much-discussed project of an under-sea power line from Sweden to Denmark appears to be on the way to execution, for according to recent reports the two countries have now authorized the laying of the cables, and the work is to be soon begun. The object of the scheme is to make use of water power in the southern part of Sweden, employing the fall of the Lagan River, and to bring this power by under-sea cable to the island of Zeeland, where it can be employed to advantage.

Wireless Telephony.—An Italian engineer, Signor Marzi, has invented a new microphone for use in wireless telephony, so that from Eiffel Tower in Paris it is now possible to hear concerts taking place in Brussels, a distance of about 225 miles. The singing could be distinctly heard, although it was not possible to make out the words of the songs. The well-known musical airs, the "Marseillaise" and the "Brabançonne," were recognized when they were being played on a gramophone 60 miles from Brussels.

Wireless Research Committee.—Under the auspices of the International Wireless Scientific Commission, there has been founded a French scientific committee, whose aim is to originate and facilitate this class of work in France and colonies, first relating to wave propagation; second, measurements in wireless work; third, study of various problems. The committee will be specially occupied with organizing researches which are proposed by the international commission. Seven to eleven active members form this body, with numerous corresponding members, and funds are to come from subsidies or donations. Prof. Branly is honorary president, and M. Blondel active president, while the list includes prominent men such as Abraham, Ferrié, Bethenod and Tissot.

Recording Radio-Telegrams with the Telegraphone.—M. Dosne has invented a method for recording radio-telegrams. He first substitutes for the telephone receiver of wireless telegraphy a sound amplifier and then connects this with the "receiver" of a Poulsen telegraphone. In this manner the microphonic current serving to convey the reinforced sounds arrives with all its variations to a bobbin of fine wire in the center of which is a pen of soft iron in contact with a rotating plate or traveling band of steel. The variations in the magnetization of the soft iron pen leave a sort of magnetic writing on the steel plate which has the property, when it is afterward passed under the iron pen which wrote it, of provoking a repetition of the original signals in the connected telephones.

New Haven Electrification.—Electrification of the New York, New Haven and Hartford Railroad between New York and New Haven will be completed probably by June 1st, as far as the overhead contact and distribution system is concerned. This will provide a continuous electrification of seventy-six miles, of which twelve miles, from Grand Central Station to Woodlawn, belongs to the New York Central. The extent to which the trains will be operated by electricity after that date will depend upon the output of current from the Cos Cob power station. The Cos Cob power plant has been extended to permit of a very large percentage of complete electric service; but it will not permit of a hundred per cent of electric service until power plants have been constructed at the eastern and western extremities of the electrification zone. Owing to heavy expenditures it has been necessary to forego the building of these additional power plants, so that complete electric operation will be delayed for an indefinite period, depending upon the general financial condition of the company and the country.

Berlin's High-Tension Service.—The Berlin central stations have been engaged, during the past, in supplying three-phase current at 6,000 volts or at 220 volts to several localities in the suburbs of towns, but within a recent date there has been made quite an extension in the electric supply system, as the plants decided to furnish current throughout quite a wide region in the surburbs. But the pressure of 6000 volts which was hitherto employed was found to be insufficient for the proposed longer lines, and this led to the adoption of a new standard of 30,000 volts for such work A special network of underground cables was accordingly laid throughout the suburbs. Upon the new plan, three-phase current is furnished by the city station of Oberspree at 30,000 volts. Six cables start from this plant in order to make up two lines of three cables each, and one of these lines covers the northern section of the region, while the other takes in the south. Each line then subdivides into a certain number of sections, in the centers of which there are erected transformer posts in order to afford a step-down from 30,000 volts to 6,000 volts. At this latter voltage, the current is brought to the different localities and is then further transformed from 6,000 to the standard voltage of 220 volts, such as is needed for consumers' use. It is to be noted that underground cables are used for the 6,000-volt as well as the 220-volt lines.

Science

The Solar Eclipse of August 21st.—In the Scientific American of April 4th, it was stated that an eclipse of the sun would occur on April 21st. This was of course a typographical error, as the next eclipse of the sun will occur on August 21st All the matter relating to the next solar eclipse is contained in the American Ephemeris and Nautical Almanac for 1914, and, with the omission of the Besselian Constants, in the American Nautical Almanac.

Within One Degree of Absolute Zero.—In a recent lecture, Kamerlingh Onnes, who has been awarded the Nobel prize for physics, remarked that we can now obtain, experimentally, a temperature which is only removed from the absolute zero of temperature by one degree. The temperature thus obtained is lower by two or three degrees than the temperature of sidereal space, which, according to the calculations of the astrophysicists, is about four degrees above absolute zero

Statistics of the Nobel Prizes.—From 1901 to 1913, sixty Nobel prizes have been awarded. If we class the prizes by countries, comparing the populations, we see that the most favored countries are the three Scandinavian countries: Sweden, Norway and Denmark, which is significant in view of the nationality of the Jury Then come Holland, France with 14 prizes and 39 millions of people; Germany with 18 prizes and 65 millions of people. After these come Switzerland, Belgium and England. Finally the United States and Russia have each received only one prize.

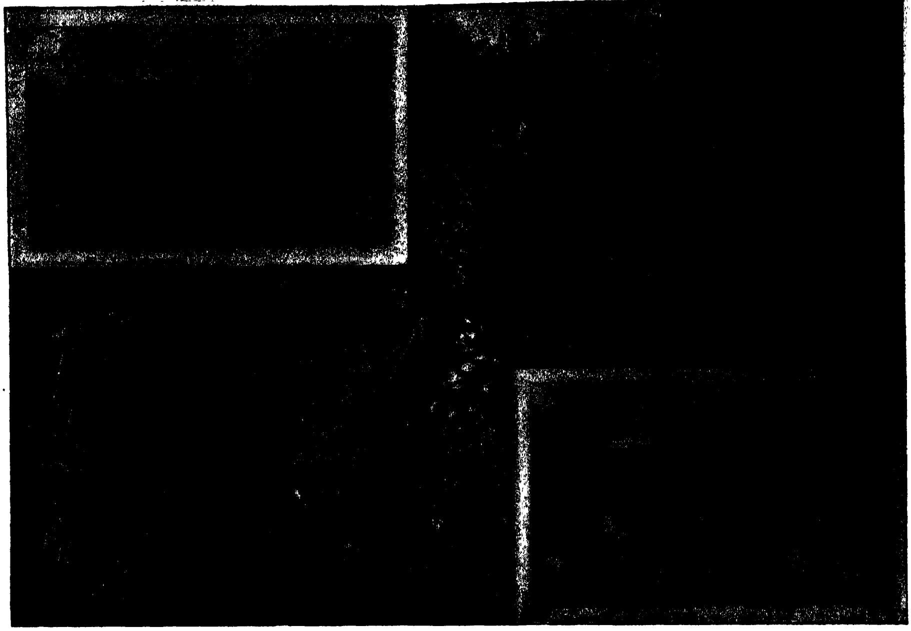
Vacuum Tar.—By distilling coal under a vacuum of 15 millimeters of mercury, Pictet and Bouvier obtain what they style "vacuum tar," this appearing to be quite different from usual coal tar Such tar contains no phenol or aromatic carbides, and when oxidized by permanganate, there are produced acids of the fatty series. The properties of this tar resemble those of Caucasus petroleum, especially constituted by hydro-aromatic carbides These experiments tend to confirm the hypotheses advanced by Berthelot and others as to the formation of the constituents of tar

An International Journal of Vulcanology.—In this age of specialization it is anomalous that the periodical literature relating to volcanoes has heretofore been scattered through a great number of geographical and geological journals, owing to the lack of a journal devoted especially to vulcanology Such a publication has now been founded, under the title *Zeitschrift fur Vulkanologie*, by Dr. Immanuel Friedlander, of Naples, and is issued by D. Reimer, in Berlin It will contain memoirs, abstracts, notes, etc., in German, Italian, French, and English.

Zoological Investigations in Panama.—An excellent opportunity of studying the fauna of the Gatun region of Panama has been afforded by the concentration of the animals in small areas, due to the flooding of the region traversed by the canal. Such investigations are also facilitated by the fact that rivers previously unnavigable can now be ascended for the purpose of collecting specimens. Accordingly Mr George Shiras, 3rd, of Washington, the well-known photographer of wild animals, and Mr H E Anthony, of the American Museum of Natural History, have visited this region, the former to take flash-lights and other photographs, and the latter to make collections

The First Pure Radium Salts Prepared in America.—A chemical manufacturing company of Pittsburgh has just announced its manufacture and sale of the first pure radium salt produced in America Of this amount 133 milligrammes of radium element in the form of anhydrous radium chloride has been sold Since the price is steadily holding to $120,000 a gramme, this is a very respectable start for the new American industry. The salt was extracted from the Colorado carnotite deposits, which are considered by the United States Bureau of Mines to be the largest deposits of radium-bearing ores in the world.

The Criminal Type. Dr. C Goring is the author of an English Blue Book which contains much valuable criminological information Following the suggestion of Dr. Griffiths, deputy medical officer of Parkhurst Prison, a large number of prisoners convicted of certain similar offenses were subjected to accurate measurements in order to ascertain whether these showed any deviation from what may be described as the normal type This material has all been tabulated by Dr. Goring. Like most modern criminologists he makes short shrift of Lombroso's "criminal type" "No evidence has emerged confirming the existence of a physical criminal type such as Lombroso and his disciples have described. . . There is no such thing as a physical criminal type. There is no such thing as a mental criminal type" The eugenists will surely find much confirmation of their theories in Dr. Goring's book "Family incidence of crime is not fortuitously distributed, it is not entirely independent of lineage; criminals do not occur equally in all families of the general community, but tend to be restricted to particular stocks or sections of the community; to those stocks tainted with criminal ancestry."



1 A giant papier maché cow twelve feet high, with entrance closed. Used to get close to dangerous or wary animals 2 Hedge cut for camera, making a natural "hide" The operator conceals himself as much as possible when filming hedgerow life 3 A novel "hide" in a forest. Subterfuge is necessary to secure good pictures of birds in their natural surroundings 4 The "hide" open, showing operator at work on a bird subject, with the camera fifteen feet above ground 5 Camera and photographer inside a tree trunk. An ingenious shelter, in order to get close to a timid bird 6 The novel artifice shown in Fig. 1 The entrance open, showing camera and operator.

Stalking wild life with the kinematograph.

Stalking Game With the Kinematograph

How the Film Has Educated Zoologists

By the English Correspondent of the SCIENTIFIC AMERICAN

NATURAL history films have shaken to the foundations many staunchly rooted beliefs concerning animal, bird, and insect life. Not so long ago a film was produced in England which aroused considerable discussion It was unequivocally stamped as a fake, but the kinematographer was able to furnish such conclusive additional proof that the incidents portrayed upon his film were absolutely true to Nature, that he was able to silence his critics The latter then, by pursuing independent investigations along similar lines, were able to ascertain for themselves that what the film illustrated was correct, and that the text books were in error

In order to secure absolute realistic films it is imperative that the pictures should be taken in the field.

In order to prosecute this branch of the kinematographic art extreme ingenuity is imperative The animals, reptiles, and birds are extremely wary and cunning, so that it is difficult to track them to their lairs. Even then inherent timidity has to be overcome so that the subject may be photographed unconsciously In one instance an indefatigable worker spent eight weeks in a stream, immersed to the thighs, in his efforts to kinematograph a particularly chary waterfowl The clicking of the mechanism proved the first stumbling block after an ingenious ambuscade fashioned from a floating tree bough had been established within a yard of the bird's nest Every time the machine commenced to whirr the bird sporting in front of the camera took fright and scurried away In order to overcome this obstacle the operator contrived a novel clockwork mechanism which emitted a noise similar to the moving picture camera, and this he set in motion in close proximity to the wildfowl's home, keeping it running continuously night and day. For the first few days the bird regarded the unwonted noise with intense suspicion, but gradually it became accustomed to the sound until at the end of a fortnight it took no notice of it whatever. Then the operator was able to proceed with his camera without frightening the bird, and as a result secured some pictures which aroused considerable interest, for the simple reason that it was the first occasion upon which this subject had been caught, while many of the incidents which he filmed were quite unknown even to the naturalist

Hedgerow life is particularly exasperating because the smallest birds for the most part are exceptionally shy One operator, in order to secure some pictures concerning one of the smallest of the feathered tribe, cut a passage through a thickset hedge, and by means of a specially contrived tripod, the length of which gave him command of the nest, he was able to film his subject in peace and quietness after he had calmed the bird's suspicions.

In another instance the operator contrived a huge dummy tree trunk with a small living apartment within. It was erected on the verge of a swamp where wild fowl gathered for the nesting season. The operator lives here for some six weeks, the apartment within being fitted up with a camp bedstead, stove, and culinary utensils Movement to and from the "hide" had to be carried out very cautiously, since in this particular instance the birds under observation have the peculiar trait of forsaking their nests, when sitting, at the slightest signs of an interloper's approach.

Extreme patience is a virtue in kinematographing wild life. Climatic conditions create an important part in the quest, while there are the birds' natural foes to be considered. On more than one occasion a half-completed film has been ruined by a tragedy of Nature, so that the whole of the work has to be done again. This applies particularly to wild waterfowl. Water-rats appear to know virtually to the minute when an egg will hatch.

One natural history kinematographer, who makes a study of small feathered forest life, utilizes a somewhat elaborate apparatus A substantial elevated platform is erected, approached by a ladder. Upon this raised platform a small framework covered by canvas is built to house the camera and the operator. But to mislead the denizens of the forest trees the whole is artfully concealed beneath a maze of branches which hide every vestige of the canvas tent, while the rounds and sides of the last are also entwined with creeping plants. In the contrivance of such hides, however, it has been found that the green growth covering the "plant" must be kept in a fresh condition The bird detects withered trees quickly, and its suspicions are aroused.

But probably the most novel "artifice" ever contrived for stalking Nature is the cow that was designed for approaching wild animals in safety. This is made of *papier-maché*, and stands no less than 12 feet in height The carcass is built of a substantial framework so as to withstand hard usage, the skin being represented by the *papier-maché* covering, colored and tinted according to Nature. Within the cow is a platform upon which the operator stands with his camera. Access to the interior of the dummy is afforded by a door in one flank, and through this the operator points his lens, the door being kept open while kinematographing is in progress. The height of the dummy enables the operator to stand erect and to run his instrument in comfort. The animal itself is mounted upon wheels so that it can be maneuvered into position. Should a study happen to observe the operator through the open door, safety is possible by closing the latter immediately, in which event the spring of the beast would be rendered abortive, although it is possible that the impetus of the leap might overturn the dummy, though this is improbable, because the feet of the artifice are heavily weighted.

By means of this device it is possible to approach such wild animals as lions, panthers, leopards, and hyenas in perfect safety. Curiously enough the objects under observation never appear to observe that the stature of the cow is decidedly abnormal. At all events, the operator who uses this dummy confessed to me that although he had approached a ferocious lion within ten feet, the animal never had evinced the slightest doubts concerning its genuine character, but had resumed his movements unconcerned.

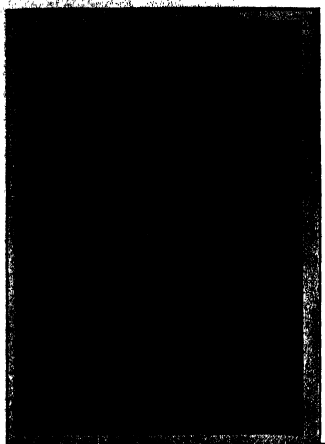
The Problem of Our Navy

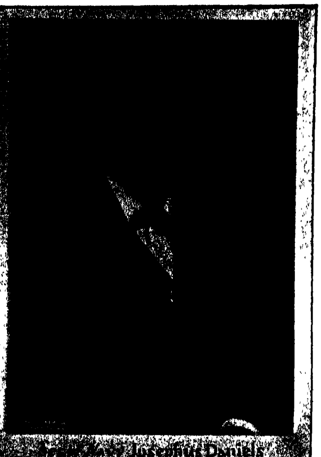
IX.—The Need of a Council of National Defense

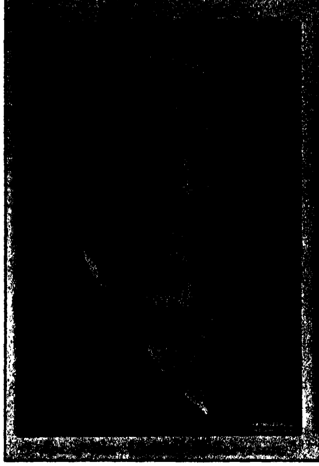
By the Editor

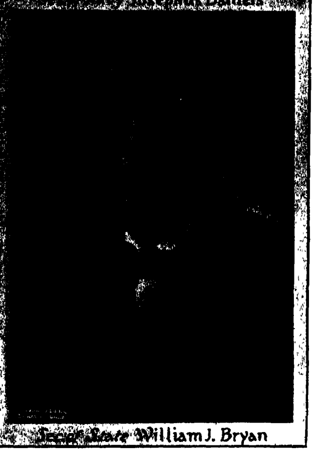
What is needed is the institution of a powerful, broadly representative board, composed of members of the Navy, of the Legislature, and of the Executive, which would consider, from every point of view, this question of naval increase and all naval questions of whatsoever kind, and present its findings to Congress with all the definite governmental authority which such a board would carry.

Illustrated by Photographs, Copyrights by Harris & Ewing









THE EXECUTIVE MEMBERS OF THE COUNCIL OF NATIONAL DEFENSE

OUR study of the problem of the United States Navy, as thus far developed, has revealed the following conditions:

I. The spirit of international aloofness in which the United States had worked out its destiny during the first century of its existence was dissipated by the unforeseen outcome of the Spanish war, whose successful military activities moved our frontiers a thousand miles eastward into the Atlantic and westward five thousand miles to the very doors of Asia. The country, so far *from deploring the new conditions, not only frankly* accepted them, but immediately proceeded, both in its diplomacy and by the increase of its naval and military forces, to make secure its position as a great world power. It reaffirmed, most strongly, the Monroe Doctrine, commenced to build and fortify the Panama Canal, boldly advocated and put through the policy of the Open Door in China, and became in the Pacific the leading exponent of the doctrine of Asiatic exclusion. Contemporaneously with this great enlargement of its foreign policies, the United States made haste to provide the *means for their enforcement*, building up its navy so rapidly, that, within half a dozen years, it had become the second naval power in the world.

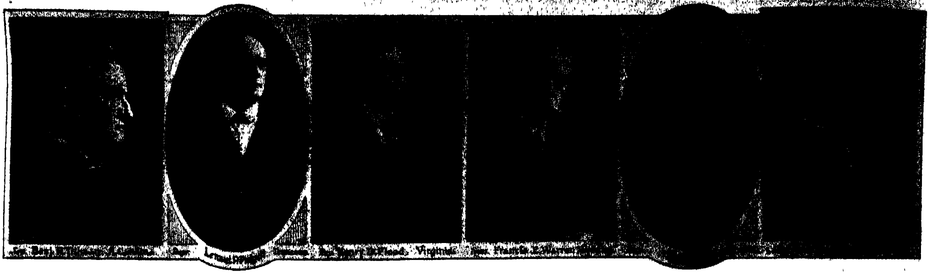
II. In the year 1905, when we had reached the zenith of our diplomatic influence and naval power, the appearance of the dreadnought produced a revolution in the rating of naval strength and threw our twenty-three first-class battleships into the second line. At this very time, when other nations began to accelerate their naval construction, building upon dreadnought lines, the United States, with that fatal lack of continuity of plan and purpose for which it has paid so dearly in years gone by, began to slacken its activities—the falling off being shown by the fact that whereas, from the Spanish war of 1898 to 1905, we had built an average of four armored ships per year, from 1905 to the present time, during the dreadnought era, we have built at the rate of only one and a half armored ships per year. As the result of this neglect, we have sunk to the position of a third rate naval power, there being one first rate power, Great Britain, with 42 dreadnoughts; *one second rate power*, Germany, with 26 dreadnoughts; and three third rate powers, the United States with 12, France with 11, and Japan with 10 dreadnoughts built and building.

III. The gravity of the present situation is aggravated by the fact that, during the period of decline of our navy in relative strength, we have asserted our ambitious foreign policies with a definiteness and in an uncompromising spirit, *for which no parallel can be* found in all the history of the republic.

IV. The failure of the people of the United States and their representatives in Congress to maintain a navy commensurate with the growing wealth of the country and the stupendous foreign policies to which it has so boldly committed itself, is due largely to the mistaken belief that the vast but undeveloped resources of the country, as regards both the men and of the materials of warfare, are a sufficient guarantee of peace—and this in spite of the fact that this very policy of unpreparedness has saddled the country with an annual pension roll of $180,000,000. Prudence demands that, as quickly as possible, our navy shall be restored to the position of second in rank which it held in 1906 To effect this our private and public shipbuilding yards should be employed to their fullest capacity, until our dreadnought line is sufficiently powerful to restore us to the second rank. The appropriation by Congress of a sum equal to that which has this year been appropriated for pensions, if spread over the next three years, would give us a first fighting line by the year 1920 which would be sufficient to preserve the peace by discouraging any conflict for the possession of the Caribbean and the control of the Panama Canal

V. Contemporaneously with the upbuilding of our first fighting line, it should be the care of Congress to make good other most serious deficiencies in the navy. The interference with and neglect by Congress of the carefully-thought-out plans of its naval advisers has led to a situation, in which we find ourselves with only three scouts when we should have thirty, with only a little over one round of torpedoes for our torpedo tubes when we should have ten rounds, and with practically no mines or mining outfits The serious nature of this deficiency is seen, when we bear in mind that the torpedo and the mine caused the loss of more ships in the Russo-Japanese war than were wrecked or sunk by gun fire.

VI. Although the fighting ships of the American Navy in their several classes are, date for date, fully equal to the best in the foreign navies, they are severely handicapped by the shortage in the personnel Of the officers and the men themselves, it may be said that there are none more efficient in any of the navies of



THE LEGISLATIVE MEMBERS OF THE COUNCIL

the world. It is in quantity, not in quality, that the ships and their personnel are deficient. In the crisis of a suddenly precipitated war, it would be impossible to man even our first fighting line with its full complement of officers and men, without robbing the reserve fleet of that nucleus of a trained force which is necessary to render it efficient Because of an obsolete method of promotion, our officers will reach command and flag rank long after they have passed that period of their lives when they would have been most efficient for the duties of these particular ranks. The remedy is to be found in a method of selection by which the most efficient officers will be chosen for promotion, those not selected being relegated to the reserve list and shore duty. To insure that the number of officers and men shall bear a strict relation to the number of ships in the fleet, the increase in the personnel should be made annually, and it should bear an exact proportion to the yearly increase of the fleet, as determined by Congress

VII. No navy can be efficient if it is not possessed of a carefully-worked-out plan of mobilization. The lack of any such plan constitutes one of the greatest weaknesses of the United States Navy to-day. A perfected mobilization implies the possession of war plans to meet all possible conditions; a personnel sufficient to command the reserve ships and auxiliaries; a large reserve of ammunition, supplies, guns, torpedoes, and coal, a full list of suitable merchant ships assigned to various ports at which they can be transformed for auxiliary service, contracts made with the owners for chartering the ships, and the possession of plans and the materials for the quick conversion of these ships to war purposes; naval stations and bases fully supplied and equipped for rapidly executing the emergency work which would have to be done on a declaration of war; advance bases, with their outfits, materials, and men ready to be transported for duty with the least possible delay; and, finally, a trained naval reserve, composed of ex-enlisted men of the navy, from which the necessary forces may be speedily sent to the coast, for manning the reserves and auxiliaries

The Cause of Our Unpreparedness.

From the foregoing it will be evident that, *although our ships and the officers and men who man them are absolutely first-class, our navy is in a chronic state of unpreparedness for war, and in saying this we wish to emphasize most strongly the fact that the blame for this unpreparedness is not to be laid upon the Navy Department* All the defects which we have mentioned and others to which we have had no time or space to refer, have been long known and greatly deplored within the Department itself. Year after year our Naval Board, which is charged with the work of deciding what the strength and composition of the navy should be, has presented to Congress a carefully-thought-out plan or programme of construction and enlargement. And year by year the programmes have been cut down and mutilated; urgently needed reforms, calling for legislative action, have been refused; and, as a result, we find ourselves to-day with a navy that is not only inadequate in numbers and strength, but the various parts whereof bear no proper relation to each other or to the whole.

Upon whose shoulders then is the responsibility for these conditions to be placed? *It is chargeable to the people of the country at large and to their representatives in Congress. So far as the former are concerned, the neglect of the navy is due either to lack of understanding, or to indifference, or to both. So far as Congress is concerned, the neglect of the navy is due to politics and the disposition of Congressmen to place local considerations and personal ambitions above questions of prime national importance.*

So far as the public is concerned, the ignorance as to the purpose and meaning of the navy can be removed only by the institution of a systematic course of instruction. This should begin in the public and high schools, whose curriculum should include the mastery of a simple primer on political economy, one chapter at least of which should be devoted to the naval and military forces of the country, in which it should be shown why these are necessary and in what proportions. If this were done, the youth of the country would grow up with the conviction that an adequate army and navy is as necessary to the national well being as the provision of a currency and a banking system.

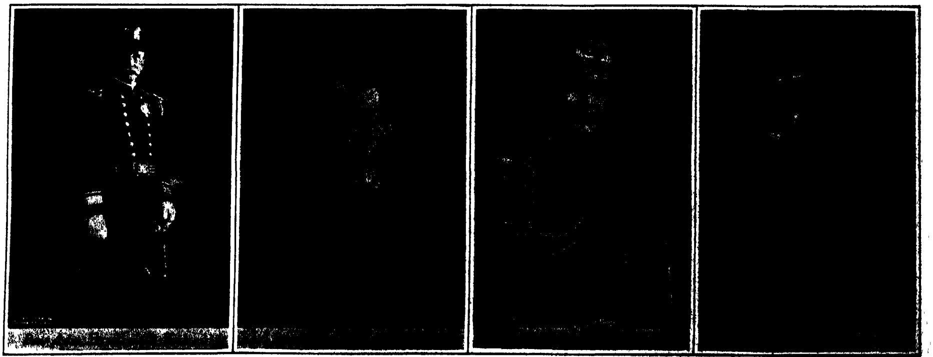
They would understand that the primary purpose of their country's naval and military forces is the same as that of a police force—the protection of the lives and property of the citizens. They would understand that the object of an army and navy is essentially pacific—that it aims to preserve the peace, not to stir up war. They would understand that, just as the 5,000,000 citizens of a great municipality like New York can go about their daily labors and sleep securely in their beds at night, only because of the strength and vigilance of a police force of 10,000 men, so the 100,000,000 citizens of this great country, its enormous wealth, and its far-reaching international interests, can be rendered secure, only so long as the country possesses an army and navy adequate for their protection.

With such tuition in the schools, the youth of the country will pass on into the broader knowledge of full manhood, with a clean-cut understanding of the need, not only for a navy, but for a navy measuring up to its multitudinous responsibilities.

The work of the schools in promoting right thinking might be, and certainly should be, supplemented by the intelligent criticism of the press. To-day such criticism is altogether too one-sided. It deals too largely in superlative approval, and tends to keep alive that feeling of national invincibility, based upon the successes of a hundred years ago, which has much to do with the present indifference to the navy, or rather indifference to the need for its enlargement. In Germany they do these things better. The children in the public schools, and the public at large through the press, have been so well instructed that they understand perfectly well what is the policy of the Government in naval affairs. Hence, the German people, by a very large majority, are thoroughly in sympathy with the naval programme. It should be so with us, and *if every important daily paper and weekly and monthly magazine maintained on its staff a naval expert, who was at all times closely in touch with the naval situation, and whose duty it was to record the absolute truth, failures as well as successes, the people of this country would have such an intelligent and sympathetic understanding of the problem, that the cheap diatribes of a Senator Burton, with his sneers at the "paid idleness" of the navy, would be received with the amused contempt which they deserve.*

So far as the relation of the Government to the navy is concerned, the present unsatisfactory conditions which have led to the decline of the navy in a few years' time to the third rank, are due chiefly to the lack of proper and intelligent co-ordination between the Executive as represented by the President and his Cabinet, the Legislature as represented by the two houses of Congress, and the Navy Department as represented by the technical advisers of the Secretary.

As matters now stand, the technical advisers as represented by the Navy Board draw up every year a programme of construction, representing the minimum requirements. This is presented to the Secretary, who, more often than not, makes a considerable reduction in the number of vessels asked for. The emasculated programme then goes over to the House, where it is subjected to more or less hostile criticism by the House Naval Committee, and by the time it is framed up into a bill, the programme usually has suffered further depletion. Then comes the debate on the bill in the House



THE ARMY AND NAVY MEMBERS OF THE COUNCIL of [illegible] and the usual fight between the so-called [illegible] and "little navy" factions. Too often the arguments against the granting of what little is left of the original minimum requirements of the navy, as advised by its technical advisers, are presented by men who have never given that thoughtful consideration to the subject which its importance demands. Local politics and party politics, which surely should have nothing whatever to do with a subject affecting the very existence of the nation, enter largely into these discussions. The vital issues, such as the relation of the navy to the national policies of the country, seem to be totally lost sight of. The attitude, both in the committees and on the floor of the House and the Senate, would sometimes seem to be one of positive hostility. Too often the suggestions of the Naval Board are treated as though they were requests for something of a personal or privileged character—as though the officers of the navy were trying to get from Congress something which would be for their own benefit.

A Council of National Defense.

What is needed is the institution of a powerful, broadly representative board, composed of members of the navy, of the legislature and of the executive, which would consider, from every point of view, this question of naval increase and all naval questions of whatsoever kind, and present its findings to Congress with all the definite governmental authority which such a board would carry.

With this object in view there is a bill before Congress for establishing what is to be known as "A Council of National Defense." We alone, among the leading powers, are without any such Council, and it is our belief that the present unsatisfactory condition of our naval and military forces is due very largely to the lack of such a body.

It has been said truly by one of our leading naval authorities, that "at present it seems to be the popular idea that the statesmen are in control up to and including the time that the solution of difficulties between nations is impossible except by resort to arms; that after that they call in the naval and military forces to cut the Gordian knot which they have been unable to disentangle, and that the making of war has little connection with the cause of war."

As matters now stand there is a lack of co-ordination, or perhaps it would be nearer the truth to say, a lack of proper means for co-ordination between the Executive, the Legislature, and the Naval and Military Departments; and the object of the creation of a Council of National Defense is to provide the proper means for this co-ordination, not merely at the threat of war or during its continuance, but permanently. If such a Council were in existence, its recommendations to Congress would be free from any suspicion of partisanship or individual departmental influence. It would be authoritative in the highest degree, and it would represent the matured opinion of the Government as a whole.

Such a Council would consist of the President of the United States, who would be *ex-officio* president of the Council, and the Secretary of State, who would preside in the absence of the President. Through the Secretary of State would be represented those broad policies of the nation to which reference has been made so frequently in the present series of articles. It would be the duty of the Secretary to keep the Council informed as to changes and extensions of our policies. Because of his intimate knowledge of the diplomatic situation, he would be able to give early forewarning of the direction from which possible complications might come. For similar reasons, the Council would include the chairman of the Committee on Foreign Relations, both of the House and of the Senate. The financial side of the problem would be represented by the Secretary of the Treasury. Technical information as to the naval and military forces which would be necessary to maintain our policies would be afforded, for the army by the Secretary, the Chief of Staff, and the president of the Army War College, and for the navy by the Secretary, the Naval Aid for Operations, and the president of the Naval War College. The legislative side would be further represented by the chairmen of the House and Senate Naval and Military Committees.

In such a Council of National Defense, the nation would possess a body of men, who, because they were in possession of full knowledge on every side of the great questions involved, would be able to discuss the matter of national defense with intelligence and authority. The plans and operations of the army and navy would be thoroughly co-ordinated, and the upbuilding and maintenance and effective use of our naval and military forces would be conducted on the highest plane of efficiency.

* * * * * * * * * * *

At the present writing the American fleet is steaming to a Mexican port to enforce the demand of the President for a salute of twenty-one guns as an apology for an insult to the American flag.

The crisis thus precipitated may bring the apology demanded—or war.

Herein is presented an object lesson on the facts and principles upon which we have dwelt in the present series of articles on "The Problem of Our Navy"—a confirmation of the need of this country's possessing a navy for the swift enforcement of its policies.

To convince the American people that we need, not only a navy, but a navy adequate to meet all possible conditions, we ask: "If the arrest of our sailors had occurred at Kiel, would Admiral Mayo have sent his ultimatum, and would our fleet be now converging on that port in its full strength?"

The Man at the Switchboard

By Henry Harrison Suplee

IT is one of the greatest claims of applied science to recognition that it is continually acting to liberate mankind from the burden of physical labor, by substituting manufactured power for the effort of muscular energy. The workman of to-day, in very many instances, uses his head far more than his hands, directing and controlling forces generated, transmitted, distributed, and applied with a minimum of exertion.

Formerly the great workshop contained an "army" of laborers, and in many cases this is yet the fact, but the proportion of men to the output is growing continually smaller, and in certain departments of industry, notably in the iron and steel manufacture, and even more in the great power houses, the small number of men, compared with conditions a few decades ago, is remarkable.

The layman, visiting the power-generating station of some important transportation system, such as that of the New York subway, or the Brooklyn Rapid Transit system, is impressed with an almost uncanny feeling that all this powerful machinery is running itself.

It is true that a few men are seen moving quietly about, but these are apparently engaged rather in watching the smoothly running engines and purring dynamos, than in any way exerting themselves to produce any immediate results. Outside, coal is being raised from barges by the edge of the river and delivered automatically to bins in the upper portions of the great building. Within, there is a quiet flow of fuel downward from these same bins into the hoppers of automatic stokers beneath long batteries of steam boilers. The grimy coal passers and perspiring stokers of the old-time boiler house are nowhere to be seen, and in their places there are a few quiet, clean men, with keen, intelligent faces, making an occasional adjustment, or glancing through an inconspicuous peephole.

Beneath the boilers the cinders and ash are being cleared away by conveyors and delivered directly to the cars by which they are removed; no back-breaking shoveling is visible anywhere. Dust, dirt, cinders, all are conspicuous by their absence, and a modern boiler room is cleaner than an old-time machine shop. The engine room, if we may use such a commonplace term to describe the magnificent hall in which the energy liberated from the burned coal is transformed through the medium of expanding steam into mechanical power and on into electrical current, is almost as bare of human occupants as was the boiler room. By careful examination a few men may be seen passing from one machine to another, not working at all in the former meaning of the term, but showing scarcely more than a casual interest, so far as the ordinary visitor might observe. The windows of the great room are bright and free from dust; the mosaic floor might well be the entrance to some modern hotel or museum, the polished hand rail might belong to the companionway of the latest floating palace of the north Atlantic. Overhead, just beneath the chords of the trusses which support the roof and permit the space beneath to be clear of pillars or other supports, may be seen the deep girders of a powerful traveling crane, deriving its power by the consumption of a trifling portion of the current generated by the whirling rotors beneath, and ready at any moment to lift anything, from a few pounds to many tons and deliver its burden anywhere on the floor below. When it is needed its full power may be directed by the effort of one man with less exertion of the wrist than is required of a player on the violin. There is no need for a gang of laborers here.

The commander of a great ocean liner has his station upon the "bridge," whence he may see all and direct everything. The commander of the great power station has also his bridge, but he needs no lookouts to signal to him, he has no need to peer through some enveloping fog to discover the approaching iceberg. The man at the switchboard has before him the quivering needles of sensitive instruments, keeping him apprised of the condition of all that is going on throughout the highly organized system committed to his care, not only within the power house, but out upon the line, and throughout the whole combination of mechanism and forces. He has no need to work hard with his hands, the control is dependent, not upon physical effort, but upon directive movements easily made and immediately effective. The switchboard is the brain of the entire system, directing the energy of the station both within the limits of the building and without, so far as the lines extend.

In such a power station we may find 100,000 horsepower generated, directed, and controlled by a force of fewer than 100 men, and these are none of them working with any serious physical effort, but using their trained minds and skilled hands to the production of far more value than could possibly be conceived under the old idea of productive labor.

When Tredgold formulated his famous definition of the work of the engineer as the "art of *directing* the great sources of power in Nature to the use and convenience of man," it is hard to believe that he did not have before him some revelation of the man at the switchboard in the modern power house.

Fatal Industrial Accidents in Massachusetts

AN interesting table, printed below, has been prepared by the Industrial Accident Board of Massachusetts to show the causes of fatal accidents reported to the commission in its recently concluded first year of existence. The total number of non fatal accidents in the State was 80,694, or about one for every ten wage-workers. The board is of the opinion that at least half of these can be prevented through improved inspection methods, by safeguarding machines before they leave the factory, by the maintenance of safety museums, through lectures, moving pictures, school talks and the elimination of danger spots in plants. There were 474 fatal accidents, classified as follows:

Railroad equipment	119	Machinery peculiar to special industries	7
Falls	66	Belting	6
Vehicles	43	Infection from trivial cuts, burns, etc	5
Hand labor	37	Saws	4
Elevators	33	Explosions (not boiler)	4
Electricity	25	Hoists	4
Street Railways	20	Illness	3
Boiler explosions and burns	15	Presses	2
Excavating	14	Gears	2
Cranes	11	Emery wheels	2
Miscellaneous	11	Occupational diseases	2
Asphyxiation, drowning, etc	10	Glass	1
Animals, insects, etc	9	Wood molders	1
Shafting, set screws, etc.	9	Assault and fighting	1
Falling material	8		
		Total	474

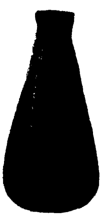
Atmospheric Electricity and Plants

A COMMON experiment to demonstrate the supposed stimulating effect of atmospheric electricity upon the growth of plants consists in covering certain plants with a metallic cage, when it is found that their development is retarded as compared with that of plants not similarly treated, the assumption being that the insulation of the plants from atmospheric electricity accounts for the difference. As experiments of this character have been prominent in the history of electroculture, much interest attaches to observations recently made by P. Lesage on the growth of species of cress and of *Datura tatula*. Plants were grown under a wire cage, as above mentioned, and also under a silk cage of exactly similar dimensions. At the end of three months it was found that the plants under the two cages had been retarded in growth to the same extent, as compared with plants grown in the open air. This result eliminates atmospheric electricity from the problem, and some other factor must be sought. It is found in the obstruction offered by both cages to evaporation. The rate was decreased by the cages 10 per cent in still air and about 30 per cent in moving air.

The Current Supplement

AN article "Machine Tools and the Motor Car Industry" in this week's SCIENTIFIC AMERICAN SUPPLEMENT describes several interesting machines used in the manufacture of automobiles.—B. J. Newman, writing on colossal waste, due to bad municipal engineering, shows how a false economy in dwelling space is paid for by the sacrifice of countless human lives.—Sir Joseph J. Thomson has recently delivered a course of lectures on Recent Advances in Physical Science. The first of these, which appears in this issue, is devoted to a new theory of chemical affinity, which seems destined to solve many problems of long standing and fundamental importance.—Alexander Del Mar contributes an article on the evolution of the breech loader.—C. H. Claudy gives an illustrated discussion of the practical problem of taking a snapshot photograph at the exact moment when a moving object, such as a tennis ball, reaches a particular position, e. g., just as it takes the racket.—Dr. O. Damm writes on blood pigment and chlorophyll in the light of modern investigation.—The principal exhibits at the Olympia Aero Show (London) are illustrated and described.

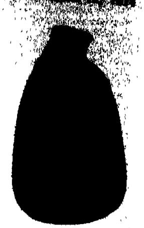
Some Interesting Wiles of the Art Faker



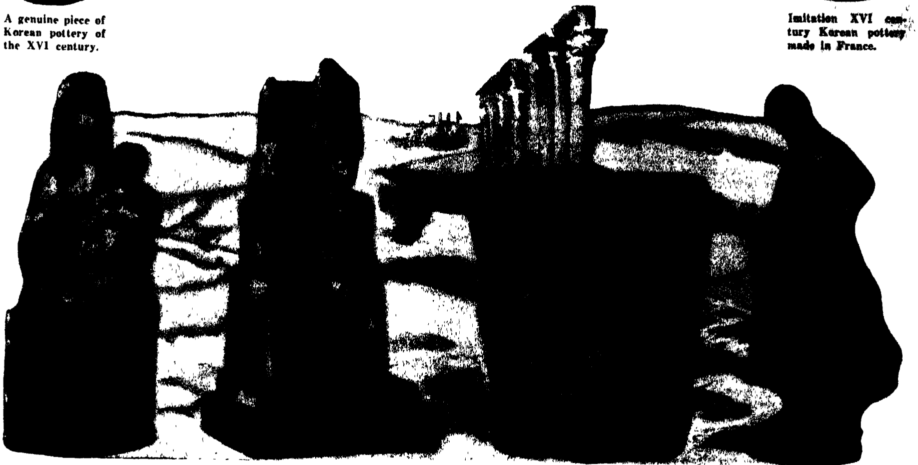
A genuine piece of Korean pottery of the XVI century.

How Patinas Are Produced to Fool the Unwary, How Old Wooden Carvings Are Produced That Would Deceive Even the Craftsman of the Middle Ages, and How the Work of the Old Potters is Reproduced for the Antique Market

By the Paris Correspondent of the SCIENTIFIC AMERICAN



Imitation XVI century Korean pottery made in France.



A Virgin Mary carved in old wood, painted, cleaned with alkali, and finally repainted. Plaster scalings have been used to heighten the deception.

An Egyptian statuette made by taking a cast from an original. The joint between the two halves is visible. An artificial coat of verdigris has been given to the object. A healthy industry in making such "antiques" thrives in Egypt.

A false keystone of modern manufacture, which has been so admirably aged that it is almost sure to deceive the enthusiastic lover of antiques. Only one familiar with methods of faking could discover the fraud.

A false Tanagra figurine made of plaster and cleverly painted. Because Tanagra figurines are in great demand there is a flourishing European industry supplying the market.

M. EMILE-BAYARD, inspector in the Ministry of Beaux-Arts, has recently published an interesting book on the "Art of Detecting Fraud," which reveals many of the technical methods employed by dealers in fraudulent antiquities. Since Americans are large buyers of old art objects, the following excerpts from his valuable work may prove helpful.

For making imitations of ancient sculpture in wood, especially of the middle ages, which were often painted, there are employed either single pieces of heavy timber or an assemblage in the case of very large work. Several pieces are assembled by the use of glue, old rusty nails or wood pins. The appearance of a painted statue is often imitated, and in this case the statue is first painted, and when dry the paint is removed, for the most part by caustic potash. Traces of color which remain in the veins of the wood or in hollow places serve to give the illusion of a statue whose color has faded, an effect which is heightened by touching up the object with gold here and there. This kind of fraud easily passes muster, for the seller of the object tells how he found it in a remote country place, and much covered with dirt, so that in order to clean it at all he was obliged take the color off with alkali. Aging of wood is often done by leaving it in a bath of acid, and when thus treated, the soft parts of the wood sink, and the fibers become prominent. Thus the appearance of age is imparted.

In treating wood in order to give it the appearance of age a warm tone is obtained by the use of walnut stain more or less diluted, depending on whether merely a mellow tone or a distinct brown color is to be obtained, then giving a wax polish by a cloth or soft brush. Unpainted wooden statues are oftenest treated in this way, and a brilliant finish is the result. The hollows are neatly filled with dust, and clumsy and evident repairs are often made in order to attract attention, and make it appear more certain that the piece is genuine. However, time gives to old wood a velvet finish which is inimitable, and by a little practice one can detect this by passing the hand over the surface. Attempts are made to imitate this finish by beating the objects, especially if they are of oak, with a thong or even something harder to reduce the angles and to close up the fibers of the wood, also to produce the effects of injury, knocks, and all the usage of time. But neither these methods, nor the patient use of sandpaper and wax polish, will give to a full degree the polish possessed by old wood, although the inexperienced fail to see the difference.

The use of the saw was unknown in old days. The hatchet was in favor. Any grooves or marks due to a circular or band saw can at once be detected, and as wood was not economized in those days, thin wood should be suspected. Old wood was assembled with wood pins as a general rule, and was not glued and rarely nailed. It is often stated that worm holes are made in wood by firing small shot into it, but that may be doubted. Worm holes can easily be made by suitable tools. Wood can be rotted by burying it in the ground, then watering the ground with acid, although the process is limited, of course, to small pieces, either of wood, stone, or metal.

A supposedly old ivory carving which has deceived a connoisseur.

Patina upon copper is produced in various ways, one of these being a treatment with sulphur vapors, which often gives agreeable iris hues. Oxidation is produced by the use of a mixture of salt and ammonia, the metal being also attacked if need be by acids such as hydrochloric or sulphuric. Metal surfaces are aged by a mixture of lampblack and turpentine, which collects in the hollows of the relief, but a more permanent treatment consists in first applying a coat of black varnish and then rubbing up the metal so as to leave the black parts only in the hollows. A patina is given to tin simply by rubbing it with garlic, or, in other cases, by the use of lampblack, but more striking effects are produced with antimony butter, more or less diluted with water, according to the degree of aging desired. Gold and silver are easily aged by applying bisulphide of carbon.

Another class of work frequently employed on metal objects is that of "embellishing" copper and pewter mugs and pitchers. Plates and the like are given extra ornaments either by *repoussé* or by engraving, so as to be much enriched. Such frauds are difficult to detect, for the object as a whole is authentic. But the added features can often be detected by examining the freshness of the cutting and tool strokes, also the color of the patina. A lack of taste in such ornaments is often evident. As regards silverware, the hall-marks or other goldsmith's marks are now imitated upon goblets or teapots, or ornaments are often added to authentic pieces. In some cases a vessel is made authentic to all appearances by using simply a real bottom piece bearing the hall-mark, and fixing it to a new vessel so that the whole appears to be ancient. Making new pieces by molding is a frequent practice, but here the hall-mark being molded and not punched is much less sharp, and the process can be detected. Great numbers of pieces are made by molding. Thus spoons are transformed into forks which are most needed in silver services, without touching the hall-mark.

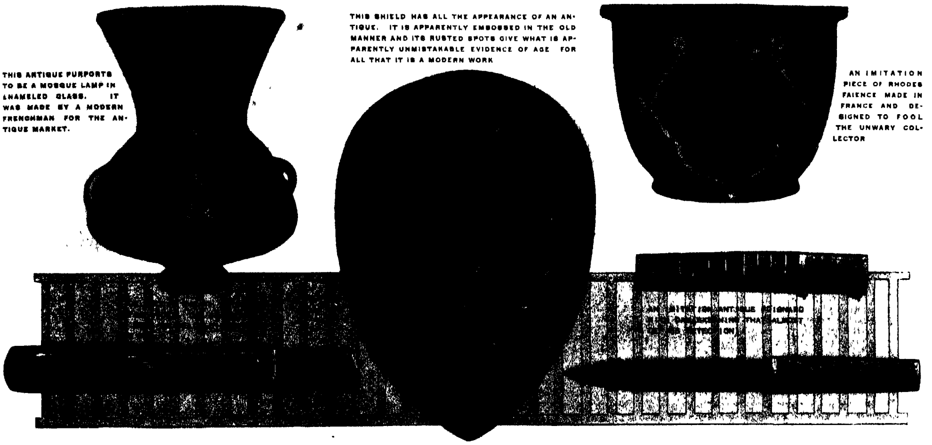
Ancient coins and medals are of course the easiest to imitate, and they are produced in quantities by electrotypers and die workers. By the galvanoplastic process an ancient medal can be reproduced with ease, and it only remains to put on a patina, to gild, oxidise, age with varnish, and the like. Another plan is to saw medals in two and use the most attractive halves, which are then brazed or soldered together. Letters or any kind of signs can be added to increase the interest of the piece, suppressing useless letters by filing them off, and in their place the new letters or signs are struck on by the use of dies. Other practices are to dip the coin in an acid which attacks the relief and changes its appearance, making it more difficult to identify frauds. For all that, the fraud can sometimes be detected, for in the first place the ancient medals were coined and not molded. Attention should be given to mold joints, which are unmistakable signs of spuriousness. In assembling pieces, the harmony of the letters on obverse and reverse should be noticed, also the unity of the field and the border, and the patina. Weighing two medals in the hand, one coined and the other molded, for equal size the cast medal is a little heavier than the other. Filing of the mold edge can often be detected in such work. As to false patina, verdigris will hardly resist the action of lemon juice, which bares the copper, and boiling water removes any varnish or other aging substances, while the real patina given by time will stand the test.

The great demand for ancient armor, which is so largely used for decorative purposes, for instance in panoplies, has given rise to a correspondingly abundant supply, consisting of shields, swords, daggers, battle-axes, and the like. It should be remembered that armor and weapons are, of course, of steel and are forged, the metal being worked by the hammer and also embossed, and each piece is assembled by riveting. If the specimens are made of iron and not steel, the fraud is apparent at once, and all pieces obtained by casting are, of course, false. Soldering or brazing was not employed at that time, at least in the great majority of cases. To increase its strength and flexibility, ancient armor was made of two pieces of sheet, fire softened and beaten together so as to weld them. Ancient helmets are made of one piece, and only the visors are added. Patina is given to iron by burying it for rusting or by sprinkling it with water or acids Exposure to weather is also resorted to, or else the piece is dipped in hydrochloric acid. In these different ways there are obtained alterations which give the appearance of age. Genuine black patina is imitated by a proper use of black varnish, which is then almost entirely rubbed off, and for imitation antique glaives in bronze, verdigris is produced by means of salt, moistened with vinegar or lemon juice. Friction upon metal, or sandpaper, is the enemy of such surface patina. Black rust is, however, often used to conceal soldering or brazing which would otherwise be visible.

The remarkable polish of ancient arms is imitated by patient rubbing with a soft cloth wet with encaustic wax prepared with gasoline (floor-wax), but an experienced eye can readily distinguish between such polish and the real one seen upon ancient steel arms. Damaskeening of arms and armor is imitated or rather supplanted by a process which is easier to carry out. In the real work, grooves are engraved in the metal by tool and then gold or silver wire is laid in; but in the other case the design is simply etched out by acids and gold in fragments or gold leaf is put in and hammered, then filed off to the level of the surface. It is easy to detect by lifting the end of the gold wire by a pointed tool, so as to draw out the continuous wire from the whole design, while in the second case only metal fragments are found. A ready imitation is to gild or silver the whole surface by the use of the plating bath, then protecting the design by varnish and dissolving off the rest of the metal, finishing by a few retouches with the chisel to complete the illusion.

To detect frauds in ceramics is most difficult. Well known potteries often imitated one another's pieces. For instance, the Rouen products were copied at Quimper, Lille, Nevers in France, and also at Anspach and Pavia, while the Nevers works imitated the Italian products from Savona, Urbino, and Faenza, and so on, so that all is confusion. Even the experts cannot find their way. Counterfeits of Bernard Palissy can be detected by noticing marks of the potter's wheel, for the real pieces were shaped by hand, being also reproduced in small number by molding. Tanagra statuettes are as innumerable as Roman lamps, but the former, at least, may rather be called reproductions, for anyone at all familiar with museum specimens can detect them on sight, that is, the ones which are commonly sold cheap, and which are made of plaster and modeled upon a frame backing, then painted and coated with a grainy material, with traces of color or gilding. The real Tanagras were made from molds, and the fineness of their details has rarely been imitated.

Old ivory boxes, statuettes, Gothic diptics, crucifixes, handles of arms, are now produced in great quantities to meet with the demand. Special composition material or modern ivory is employed, with a suitable patina to imitate age. Cracks are made by dipping in boiling water and holding to hot fire, thus producing expansion and cracking, and a mellow hue is given by fumigations of tobacco, tanbark or wet hay A bath of ocher, rubbing with turpentine and Judaea bitumen, licorice juice or lampblack, are all employed. Round shapes can often be detected by noticing the circular marks of the lathe, for instance on a box bottom, and various patinas can be washed off with alcohol or even water. Celluloid is sometimes employed for this purpose.


THIS ANTIQUE PURPORTS TO BE A MOSQUE LAMP IN ENAMELED GLASS. IT WAS MADE BY A MODERN FRENCHMAN FOR THE ANTIQUE MARKET.

THIS SHIELD HAS ALL THE APPEARANCE OF AN ANTIQUE. IT IS APPARENTLY EMBOSSED IN THE OLD MANNER AND ITS RUSTED SPOTS GIVE WHAT IS APPARENTLY UNMISTAKABLE EVIDENCE OF AGE FOR ALL THAT IT IS A MODERN WORK

AN IMITATION PIECE OF RHODES FAIENCE MADE IN FRANCE AND DESIGNED TO FOOL THE UNWARY COLLECTOR

AN [illegible] ANTIQUE [illegible] [illegible] THAT [illegible] [illegible]

Some remarkable imitation antiques.

Antarctic Meteorology

THE meteorology of the Antarctic was altogether enigmatical a little over a decade ago. To-day the observations of the numerous recent expeditions are beginning to make clear its principal features, though much work in this line remains to be done. The most comprehensive summary of the subject is that published by Prof. W. Meinardus in the January number of the *Geographische Zeitschrift*. Series of meteorological observations have now been made at three fixed stations in West Antarctica (the Swedish station at Snow Hill, 1902-03; French station at Port Charcot, 1904-05; French station on Petermann Island, 1909), and at five in East Antarctica ("Southern Cross" station at Cape Adare, 1899-1900; 'Gauss" station, Kaiser Wilhelm Land, 1902-03; English stations at MacMurdo Sound, 1902-04, 1908-09, and 1911-13; Norwegian station "Framheim," 1912-13; Australian station in Adélie Land, 1912-14). All of these lie on the coast, the most southerly being "Framheim," which was over 800 miles from the pole. From the interior we have only the relatively unsatisfactory observations made by sledging parties. To a third class belong the observations made on vessels drifting slowly in the ice, as in the "Belgica," "Scotia," and "Deutschland" expeditions. Lastly, some of the latest Antarctic expeditions have secured numerous observations of the upper air with the aid of kites and balloons. The most remarkable series of such observations was that made by Lieut Filchner's meteorologist, Dr Barkow, who carried out no less than 255 flights on 200 days during the ice-drift of the expedition in Weddell Sea On one occasion a pilot-balloon was sent to an estimated altitude of 56,430 feet, or about 10.7 miles. Much knowledge of the upper air currents has also been obtained from observations of clouds The Antarctic has surprisingly cold summers Roughly speaking, the warmest month in the year has a mean temperature of 32 deg Fahr (the freezing-point) or below everywhere inside the Antarctic Circle, in spite of the continuous sunshine of that season, while in the neighborhood of the pole at the same season the temperature may fall to about 60 deg. below zero Fahr.; an intensity of cold that can hardly be explained merely by the altitude of the Antarctic plateau, great as this is. The winter temperatures (April to September) are remarkably uniform; there is no month of decidedly lowest temperature as in the Arctic At Framheim was recorded the lowest average yearly temperature heretofore found anywhere in the world, viz., 13.4 deg below zero Fahr Prof Meinardus advances a novel and interesting theory of the atmospheric circulation in the Antarctic Between latitude 60 and 70 a trough of low barometric pressure runs around the globe, south of this the pressure rises, forming the polar anticyclone. The strong easterly winds of the Antarctic coast he believes to be fed by air brought from lower latitudes by the cyclonic circulation This explains why they are not dry winds, as they would be if they came from the interior of the continent and belonged to the anticyclonic circulation Lastly, the polar anticyclone is a shallow one, and in the interior does not even extend as high as the land itself Above it lies a polar cyclone, which draws in air from the north This air comes from a vast oceanic region, and its moisture feeds the great continental glacier under which Antarctica lies buried, making good the loss due to evaporation and to the flow of glacier-ice into the sea

The 100-inch Telescope

THE vicissitudes attending the task of building a 100-inch reflector—by far the largest telescope in the world—for the Mount Wilson Solar Observatory have been watched with interest and anxiety by astronomers for nearly eight years At last the successful grinding of the great mirror is so far assured that active work has been begun on the construction of the mounting and dome. Foundations have been laid for the observatory building, and the telescope pier is about finished. The latter measures 20 by 45 feet at the ground-level and is 33 feet in height.

Driving Machine Tools With a Motorcycle

A MECHANICAL genius in Gettysburg, Pa., not only rides his motorcycle to and from work, but keeps it busy in his shop. He has rigged a device that makes it a portable power plant, operating his grinding machine. His specialty is sharpening lawn mowers, and he can double his day's output with less labor by this method. The engine is kept cool by fans, one on each side of the machine, which keep a stream of cold air blowing on it while running, and the machine often operates half a day at a time without overheating.

Motorcycle as a power plant in the amateur's shop. The engine is kept cool by means of fans.

Giant Penguins

THE accompanying photograph shows four giant penguins from the Antarctic (South Georgia). The two parent birds are white and dark brown. The young birds are covered with long gray-brown hair; it is, in fact, more like hair than like down or feathers. These penguins are also known as "royal" penguins, because of the appearance as of a regal mantle that fastens around the throat and hangs over the stumpy wings. The young have not yet grown such a mantle. These birds have just been presented to the Rotterdam Zoological Gardens, and every care will be taken to make them survive a Dutch summer. They walk upright and are very tame.

Four giant penguins from South Georgia which have been presented to the Rotterdam Zoological Gardens.

Water Power Pumping Plant of Paris

THE water wheel plant installed upon the Seine at Bougival and known as the "Marly machine" is one of the curiosities of the suburbs of Paris. Installed in 1858 in order to raise the water of the Seine up to Versailles for the use of the numerous fountains and basins of the chateau and also for the town water supply, the present plant has been in continual operation since that time, and is likely to hold out for many years to come. The first Marly machine was built in 1680. It used quite a number of water-wheels, together with such a pumping outfit as could be contrived at the time, and was, in fact, quite a success in such a primitive stage of the engineering art. But in course of time the plant finally wore out, and was first replaced by a small steam engine plant, which was scarcely able to elevate enough water for the city use, not to speak of the fountains, but at a later date it was decided to erect the present outfit under the direction of the eminent engineer, Dufrayer. The wheel house extends part way across the Seine, and the water flows underneath the building so as to drive the undershot wheels, these being five in number, 15 feet wide and 40 feet in diameter. They are each connected to four horizontal piston pumps, one of which can be seen in the foreground. The [illegible] capacity of the pumps is upwards of [illegible]000 cubic feet per 24 hours. Owing to the fact that the city uses part of the water, it was decided to discontinue the use of Seine water in 1898, and to obtain a purer supply from a number of large wells in the region of the Seine, so that the pumps now deliver pure water to the city, this being further passed through sand filters located near Versailles.

The forty-foot water-wheels of the "Marly machine," which pump the water for the fountains of Versailles.

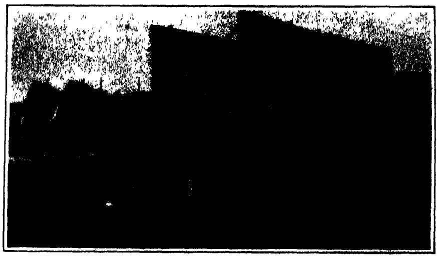
A Light Machine Gun

A NEW French machine gun has recently been adopted by the American army. This weapon is hardly larger than the rifle carried by the soldiers, and yet is capable of firing 200 to 500 steel bullets per minute. It takes two men to operate it. One man feeds the long strips of cartridges into the breech of the gun from the right, while the other man aims and keeps the stream of bullets pouring in the right direction. The gun weighs only 35 pounds, and, therefore, can be easily carried by one soldier. It dismounts in three pieces, which can be assembled again for action in 10 seconds. It works close to the ground, and the operators lie on the ground, which does not make prominent targets of them. No heavy tripod is necessary for its mount. The objectionable water jacket of other machine guns is eliminated and an air-cooled radiator takes its place, which saves about 25 pounds in weight. The cartridges used are in strips of 25 each, and are the same as used by the soldiers in their rifles. The bullet weighs one half ounce, and is of steel with a lead center.

Thirty-five-pound, air-cooled machine gun, capable of firing 200 to 500 shots per minute.

Folding Bandstand on Wheels

PROVIDENCE, R. I., hires bands to give free concerts once a week in each of the parks scattered about the crowded districts. But the city did not care to build bandstands at each park, since each is used very little. Accordingly, the Park Commissioners had a portable folding bandstand built for them. When the outfit was completed it weighed 3,400 pounds. The stand, when open, has floor space of 20 by 35 feet, and will hold thirty-five chairs. The rims of the wheels are very wide so as to protect the park grass. When opened, the sides are supported by upright pieces which extend sufficiently far above the stand for electric lights to be suspended from them.



Folding bandstand on wheels, which is hauled around to various parks where public concerts are given.

The United States Forest Service is using gasoline railway speeders for fire protection purposes. They follow up trains on steep grades where sparks thrown out by forced draft are likely to start fires.

Hands Misplaced in Egyptian Paintings and Sculptures

By James Arthur

DURING a journey up the Nile in 1908 I noticed, for the first time, a strange mixing of right and left hands in ancient Egyptian art, although I had been in Egypt before. So marked is this error that, I think, a count would show hands properly placed to be in the minority. In Fig. 1 we have Rameses I making an offering to the god Osiris, with two *right* hands, while the god's hands are correct, the "Key of life" in his right. In Fig. 2 Seti I is shown holding up his elaborate offering to the goddess Isis, with two left hands. The hands of the goddess are reversed. She holds the "Key of life" in the right hand at her left side! In these four we have all possible combinations: two rights, two lefts, right and left reversed, and right and left correct. When we consider that this went on for thousands of years it looks amazing. Surely the artists know what they were doing? Then how about the public? In trying to find some reason I noticed that the sculptor placed the thumb next the eye of the observer. This quite regardless of accuracy, it will not do to say "convention." We have plenty of conventions, especially in fashion plates, but we do not reverse things.

These photographs are from sculptures in the sixth Egyptian room of the Metropolitan Museum of Art, New York city. An Egyptologist writes me that he cannot find anything printed on this matter either before or since 1908, in which year I mailed postal cards from Egypt, showing the errors.

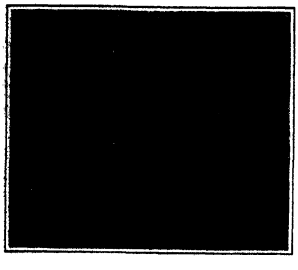


Fig. 1.—Rameses making an offering to the God Osiris, with two right hands, while the God's hands are correct.

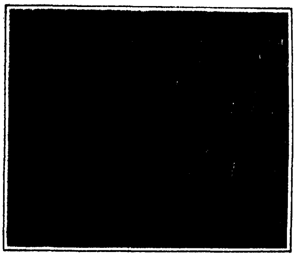
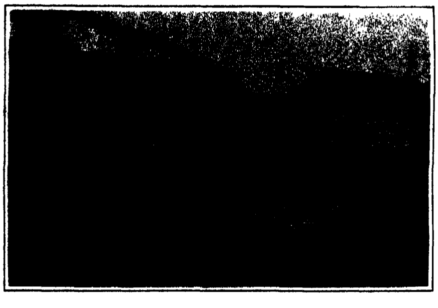


Fig. 2.—Seti I holding up an elaborate offering to the Goddess Isis, with two left hands. Hands of Goddess are reversed.

A Sectional Dumping Car

HERETOFORE most of the dumping of roadbed material for electric lines has been done by platform labor. A modern type of dump car has recently been developed that not only does away with the unsightly string of dump cars formerly used, but eliminates the danger of running such a train of cars through congested city districts, and at the same time reduces the cost of platform labor about 50 per cent. Through the suggestion of the Public Utilities Commission and the co-operation of an electric line and well-known car builders of Springfield, Mass., the electric dump car shown herewith has been developed. The new car has four compartments which take the place of three cars of the old type. The sections can be emptied separately, or at one time. When all are dumped it requires but one minute's time. The dumping is done by cables attached to the lower corners of each section, and which run over sheaves at locations 3-3 and 4-4. When fully loaded the new carrier conveys 24 cubic yards of crushed stone, each separate section having a capacity of 6 cubic yards. Weight of car with maximum load is 72 tons; without, 21 tons. The car is equipped with four 40 horse-power motors, and air brakes. It was built at a cost of about $6,000. In the cab of the car is a 10 horse-power motor for dumping the load.



Car that may be dumped a section at a time.

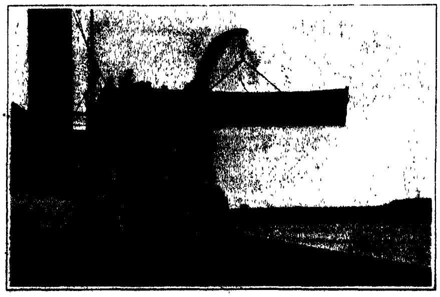
Single Boat Davit

ONE of the chief disadvantages of the common system of launching lifeboats lies in the use of two separate tackles which must be operated separately. During the panic of a shipwreck this is a source of serious confusion.

A new system of center slinging has been devised by Capt. Graham, a Glasgow shipmaster, which permits of using but a single davit, thereby greatly simplifying the launching operation. The accompanying photograph shows a davit of this type designed to handle a 28-foot lifeboat weighing 1¾ tons. The davit has a swivel bearing in the promenade deck and passes through a gland in the boat deck. The boat is hoisted by chain, which is doubled from the head of davit, led through a single sheave block, to which is attached a patent disengaging gear, which is absolutely *automatic* and cannot fail; for as soon as the boat is water borne the gear is bound to disengage.

Two men can launch the lifeboat in 50 seconds. The block can be recovered in 40 seconds ready for hooking on the second boat. On the "Titanic," the time occupied in rounding up and clearing manila tackle was 1 hour 15 minutes prior to hooking on the second boat, while the time taken on the "Olympic" at Southampton was 25 minutes, with 12 men operating. The lowering is under efficient automatic brake control, enabling one man to lower with speed and safety, on an even keel. The hook being positive in action releases the load automatically as soon as the boat is water borne. The chain travels over a sprocket wheel and stows in the hollow bottom of the davit. No handling is required, while fouling is entirely avoided. The davit may be readily modified to be operated by an electric motor.

The single davit has been subjected to most exhaustive tests by the British Board of Trade at various ports in Great Britain and has gained a certificate of approval for passenger vessels.



Launching a lifeboat with a single davit.

New Way of Treating Raw Silk

THERE is perhaps no industry in the country that has gone through so many stages of experimentation as that of silk dyeing, and it is by reason of this very fact that the silk industry has grown to such enormous proportions in the United States. A new process is now being used in the large silk-dyeing houses for the purpose of loosening the slender threads of raw silk that compose the skein, so that they will more readily "take" the dye. When the silk arrives at the dye house, after being packed in bales perhaps for months, the tiny threads are so closely pressed together that they must be separated as much as possible, and as this is not practicable by mechanical means, chemical processes must be resorted to.

Formerly this object was accomplished by using large boxes, about thirty feet long, three feet wide and three feet high. These boxes were filled with a weak solution of phosphate of soda, and the silk skeins were suspended on small wooden rods placed across the top and extending a few inches beyond the sides of the boxes. The silk was then moved back and forth in this bath by two operatives working together, one on each side of the box. At frequent intervals the silk was turned by the workmen so that all parts of it became immersed in the liquor. This process continued for about an hour, when the silk was taken out, washed and dried. The operation was repeated several times while the silk was passing through the various stages of preparation for dyeing, and it was slow and laborious work.

By the new process the phosphate of soda, of five degrees specific gravity, and heated to fifty deg. R. is placed in a series of rubber tanks, these tanks being connected with large hydro-extractors, each having a capacity of four hundred pounds of silk. Each one of the rubber tanks is supplied with a coil of lead pipe placed in the bottom through which a constant pressure of steam is forced for the purpose of heating the liquor to the required degree. The strength of the phosphate of soda solution also varies somewhat, according to the kind and quality of silk to be treated.

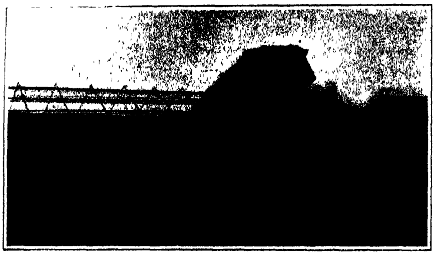
The silk is packed loosely in the hydro extractors, so that the phosphate of soda may thoroughly permeate every part of it and the machine is then slowly revolved while the phosphate of soda is pumped into it from the rubber tanks. As soon as they are filled the flow of soda is turned off and the hydro extractors continue to revolve slowly for about an hour. In this way every part of the four hundred pounds of silk which they contain is thoroughly permeated, and the fine threads of silk loosened in the skein and separated from each other, so that they can easily become saturated with the other chemicals and dyes used in the process of dyeing.

At the expiration of an hour the hydro-extractor is stopped and the phosphate of soda solution allowed to run back into the rubber tanks until the machine is empty. The hydro-extractor is then rapidly revolved or "whizzed" for ten or fifteen minutes until the silk is thoroughly dry. It is then taken out and a fresh supply of silk is put into the machine. The silk is washed on a washing machine, dried in a smaller hydro-extractor, and is then ready for the subsequent processes. By means of the new method of treating the silk the output of the dye houses is increased about one fourth and the cost of treating the silk materially reduced.

Sponges as a Fertilizer.—Mr. Joseph G. Smith of the United States Bureau of Soils has called attention to the present use and future possibilities of the loggerhead sponges of the Florida Keys as a fertilizer. They are said to grow in countless thousands in shallow water, where they are easy to gather, and citrus groves on the neighboring mainland have been fertilized with them with very satisfactory results.

The Motor-driven Commercial Vehicle

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The Editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles.



The dumping truck serves a variety of purposes.

Giving the cow a ride.

The Motor Truck on the Farm

By Ross Babcock, M.E.

TO the imaginative man, the place of the horse on the modern farm already has been taken by the massive motor truck and the scarcely less feebly kicking gasoline-motor-of-all-work. For though there is no new thought in the expression "the horse must go," the suggestion is there just the same—and it is a suggestion that is all the more potent because of the rapid strides that have been made by the farmer during the past year in adopting for his very own the type of horseless vehicle that was designed primarily for more densely populated trade centers, where the call of the crow and the smell of the soil never penetrate.

Part of the suggestion is conveyed by the very evident manner in which the present-day motor truck builder is endeavoring, either directly or indirectly, to cater to the needs of the farmer. He is endeavoring not so much to give the farmer what the manufacturer thinks he ought to have as to give him what he wants, *never once forgetting*, however, that minds trained to the ways of the draft animals may not be quite as quick as are other minds to grasp the significance of specially developed vehicles that not infrequently appear to the less sophisticated layman somewhat as round pegs in square holes

The manufacturer has shown by his attitude that he is willing and anxious to hold out a helping hand to the man behind the plow—to assist him to a better place in the world by solving at least a part of his transportation problems for him And *that the manufacturer really is sincere* in his manifestations scarcely permits of question, for he knows that as a general rule the farmer will be far more considerate of his power-driven equipment than will the average individual engaged in some other business, and that the ultimate benefit will be as much his own as it is the farmer's

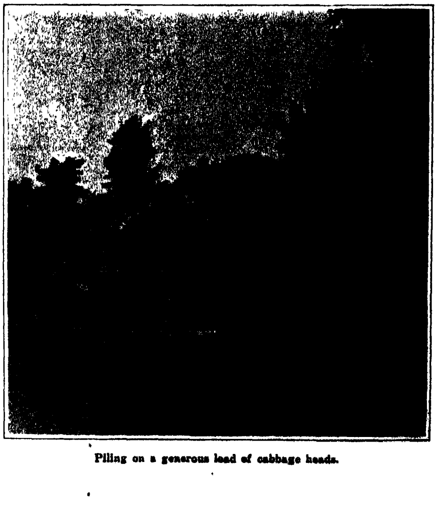
In many respects, the farmer whose acres lie within a radius of fifty miles or so of a big metropolis has a distinct advantage over his brothers whose farms are located less conveniently to the *ultimate market He can*, if he will, transport at least a part—probably the more perishable part—of his produce by motor truck more quickly than by railroad in a great many cases, and with greater certainty that it will reach its destination on time and in prime condition

As just one concrete example of the superiority of the motor truck over the horse-drawn vehicle, the case of one influential Long Island farmer may be cited With a five-ton truck, this man, whose farm is situated about thirty-five miles from the New York market, carries twice, and sometimes three times, as much produce to the city in one load as could be carried by one wagon and team, and he does it in a fraction of the time, and at a fraction of the cost of his horsed equipment.

For work of the kind, the heavier type *of vehicle of from three to five tons capacity* is the best, and in this connection it is interesting to note the tendency toward increased efficiency by reducing idle time to the minimum. The removable body has had an exemplary effect in promoting efficiency.

In operation, the removable body—*generally there are several of them where the* volume of the work warrants—is loaded while resting upon a "dead" wagon, which can be moved either by hand or by horses nearer to the work as the loading progresses. The truck chassis is in the mean time employed in doing other work, or, where several removable bodies are used, *in transporting* a load in one of them. "Dead" wagons are not necessary, of course, though they are a convenience. The removable bodies may be dismounted (by the power of the engine, be it added) upon suitable platforms conveniently located.

Hauling a heavy load up hill.



Piling on a generous load of cabbage heads.

How does all this affect the farmer? Let us suppose a hypothetical case which may not be so hypothetical after all. Farmer Smith is located, say, three or four miles from his nearest railroad shipping point. What will one three-ton chassis and three removable bodies do for him?

Assuming that one body is continually on the chassis *en route* to or from the station, which is the theory of motor trucking for real efficiency, the other two rest on easily erected loading platforms near to, or actually in, the field where the harvesting is being done. The truck returns from the railroad station minus its body, which is unloaded during the time the truck can return to the field, pick up another loaded body and make the trip to the station. Arrived, the unloaded body is substituted for the loaded one and the process repeated as many times as may be necessary.

By such means it is possible for the farmer to get all of his produce actually on the market days before "the other fellow," and, therefore, he is in a position to command better prices.

Needless to point out, a motor truck always can be used as a tractor and quite frequently it is possible to load the truck itself and then to hitch an ordinary produce wagon on behind for a trailer, in this way practically doubling the capacity of the truck.

Where the ordinary produce wagon is used for a trailer, however, a note of warning against excessive speed should be apparent, for obviously the wagon is not constructed for speed and cannot be expected to "stand up" under the strain of other than a moderate rate of progression.

As a means of carrying dairy products to a nearby market, there is much to be said in favor of the lighter power wagons. They are economical and comfortable, for as a rule, they are better sprung than are their horse-drawn predecessors—they must be better sprung to protect their mechanism—they are easily operated, and last, but not least, no weather holds terrors for them. They will fairly skim over ice and snow, and there is no necessity for curtailing speed. Similarly, they offer exceptional opportunities for providing protection for the operator, for though

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Inquiry No. 9357. Wanted the name and address of a manufacturer of a machine for scalloped paper favors and cups.

Inquiry No. 9358.—Wanted the name and address of maker of a machine to cut all granulate leather

Inquiry No. 9359. Wanted the name and address of a firm that makes razor blades for all makes of safety razors.

Inquiry No. 9360 Wanted the name and address of parties making pipe fittings such as ferrules, stems and bowls such as could be used in the making up of calabash pipes for smoking

Inquiry No. 9361. Wanted to buy a Nut Cracking Machine, especially good for Pecans.

Inquiry No. 9362. Wanted the name and address of the makers of a machine for splicing ties.

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Inquiry No. 9365. Wanted the name and address of a manufacturer of machinery for embossing tin foil as is used in packing cigarettes.

Inquiry No. 9366. Wanted the name and address of a manufacturer of wire wheels, front axles complete with steering or separate, light sheet metal bodies, fuel tanks with cocks, pressed steel frames, mufflers, motors of the two cylinder opposed type, cushions and many smaller parts for cycle cars.

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Inquiry No. 9370. Wanted the names and addresses of manufacturers of small wooden articles, particularly in such soft woods as pine and fir, for articles such as toys, furniture, etc.

Inquiry No. 9371 Information wanted where one could buy or have made to order machine to be used for making solid back brushes.

Inquiry No. 9372. Wanted the name and address of [illegible] of a collapsible box about 15 inches [illegible] made to withstand [illegible]

the horse may be overloaded by such extra weight as is represented by a closed "cab" the power wagon carries it easily.

Buying the Truck on the Instalment Plan

By James McLean Helford

IN many instances, the intending purchaser of a motor truck is confronted with one or both of two difficulties—even after he has become convinced that a commerical vehicle installation will prove profitable in his business. He may be unable to supply the necessary capital to purchase an expensive truck outright; or he may have so large an investment in horse and wagon equipment that he could not easily convert their value into cash. In the latter instance, it would prove far more profitable for the owner to sell his horse and wagon equipment piecemeal and to invest immediately in one or more of the necessary trucks—as his business warrants.

But to such would-be purchasers of motor trucks, many manufacturers and dealers offer relief. While there may seem to be more or less odium and a sense of instability attached to the word "instalment," it represents a pure and simple business proposition, and is a plan whereby many a reputable merchant is enabled to continue with a profitable enterprise. Just as no large office building is erected for "cash" or is completed without the floatation of bonds or mortgages, so should it hardly be expected that every large business house would be willing to purchase its entire commercial vehicle equipment in a lump sum. But if a man desires to take advantage of any of the several instalment or "part payment" plans of selling motor trucks, he must first convince the manufacturer or dealer of his reliability and financial standing It is evident, therefore, that the credit department of the truck manufacturer takes an important position in regard to these time sales, and the business record of the intending purchaser is carefully investigated.

Further than this, the truck companies do not look with favor upon propositions in which it is found that the would-be purchaser is depending upon the truck itself to show a sufficient profit to meet the payments and interest when they become due. Improper handling, wrong routing, or many another condition can seriously affect the earning capacity of a motor truck, and therefore the intending purchaser must of necessity be able to show other sources of income before he can be considered a fit subject for the receipt of a car on the instalment basis. The purchase of a truck in such a manner, therefore, betokens strict business integrity, and far from being the rather questionable undertaking that many consider it, it becomes a high-class, legitimate proposition.

One large concern that has recently adopted the instalment system of selling trucks charges the full list price for vehicles so purchased. Twenty-five per cent of this list price is exacted to include the delivery of the truck, and the remainder is due within one year, in the form of twelve, equal, monthly payments. These payments are guaranteed by notes which bear six per cent interest and which, in some instances, must be indorsed by the dealer consummating the sale. In addition, the purchaser, upon delivery to him, must insure the truck for one year to cover fire, accident, and liability, and while such policies may be made out in the buyer's name, they must bear an indorsement in the form of a "rider," signing over to the manufacturers the amount of the policy, "as their interest may appear"—as it is stated in insurance parlance.

This provision regarding the insurance is made because the manufacturer holds title to the truck until the last of the notes, together with interest, has been paid. In order to establish this title, a lease or a chattel mortgage on the truck must be executed before the proper officer. Inasmuch as the law regarding the nature of such an obligation varies in different

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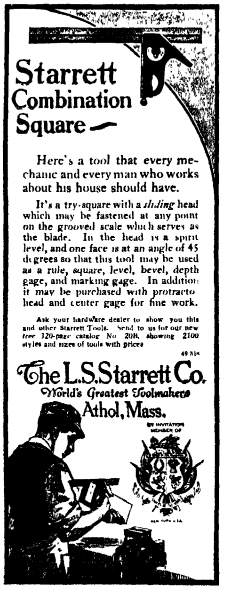
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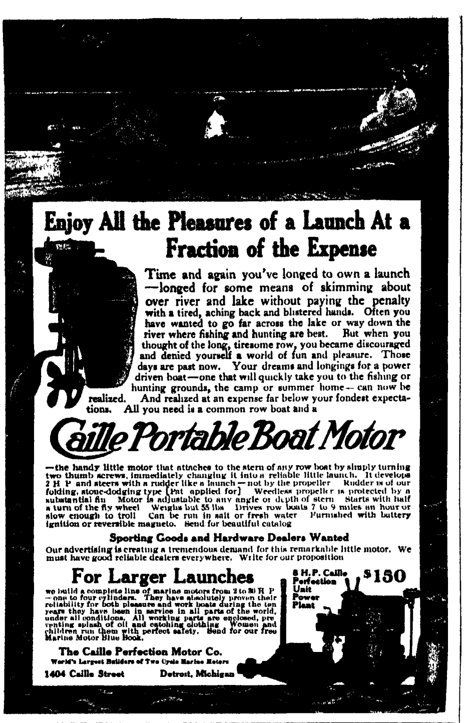

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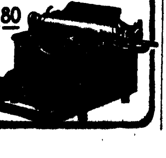

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States, such papers must be passed upon by the purchaser's attorney, who must make a written statement to the effect that the lease or mortgage as executed is prepared according to the legal form exacted in the State in which the purchaser of the truck and the signer of the notes resides. He must also certify that such papers have been properly recorded in order fully to protect the manufacturer in the case of default on the part of the intending purchaser.

In order to make such an instalment system the more clear, let us consider the case of a light truck selling at an arbitrary figure—$1,350 say, to make the calculations "come out even." One fourth in some instances, and one third in others, is to be paid in cash. Assuming one third of the total to be required at the time of purchase, the cash due is $450, and the remaining $900 is to be paid in the form of ten or twelve monthly notes, with interest at 6 per cent.

In addition to the 6 per cent interest charged on the notes covering the unpaid balance on the truck, some concerns purposely charge on the basis of a greater total than that for which the truck could be purchased for cash. That is, for example, 6 per cent will be deducted from the list price that forms the instalment plan charge, if the truck is to be purchased for cash, and the buyer therefore saves, not only the interest on his notes, but also an additional 6 per cent on his investment.

The fact that many hard-headed business men have taken advantage of these instalment offers on the part of some of the motor truck manufacturers is evidence of the soundness of the business policies involved The motor truck business is still in its infancy, and it is but natural that such inducements should be made to prospective buyers as are offered to purchasers of articles that have been before the public for a much greater length of time. If the motor truck is indispensable, as it is surely proving itself to be, it should be made available for every small merchant and truckman who now uses but one or two horses and wagons, as well as for the large department store employing a fleet of a hundred commercial vehicles in its delivery system.

Motor Truck Notes and Queries

P. B. J. writes: "Why are the dual, or twin, tires used on large trucks? Would it not be cheaper to use one large tire on each rear wheel?"

A. The weight carried by each inch of tire width should not exceed a certain amount Therefore, when a heavy truck is loaded with several tons, the required width of tire becomes so great as to make a single tire exceedingly unwieldy. Furthermore, the cost of production of such a tire would be greater than that of two of one half the width It is also possible that one of the dual tires would wear more rapidly that its companion on the same wheel, and in this event, only the imperfect one need be replaced Another important consideration in favor of the use of dual tires on large trucks is the better facilities afforded for attaching the two separate tires to the rims of the wheel.

H. J. W. writes: "I understand that ten or twelve miles an hour is the speed limit recommended by tire and truck manufacturers for vehicles of three-ton capacity. I have heard the term 'high-speed trucks' used, however, and would like to know what is the speed and capacity of such, and what is their tire equipment."

A. Such vehicles are really more of the nature of delivery cars than trucks, for their total load seldom exceeds three quarters of a ton. A commercial vehicle of this type may be run at twenty miles an hour, or more, while many have speed capabilities of thirty and thirty-five. In the latter instance, pneumatic tires should as a rule be used, for their greater resiliency enables such speeds to be obtained without seriously affecting the motor, transmission, and other mechanical parts. Solid tires can be used on light trucks that do not exceed a speed of twenty

Where were you when the Chicago fire occurred?

Do you remember that great fire?

They said old Mrs. Leary's cow kicked the lamp over.

If results go for anything, that was the record kick for all time. For when that little blaze was stopped $290,000,000 worth of property had been wiped out.

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1514 tells you how to make a coil for gas-engine ignition.
1522 explains fully the construction of a [illegible] coil and condenser for [illegible]
1124 describes the construction of a [illegible] spark coil.
1087 gives a full account of the making of an [illegible] current coil giving a [illegible]-inch spark.
1527 describes a [illegible]
1402 gives data for the construction of coils of a definite length of spark.

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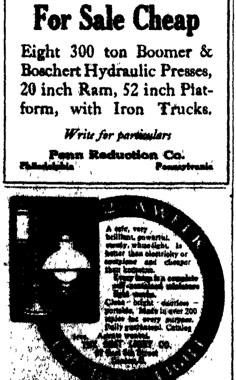

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miles an hour, but as a rule, pneumatics are the more popular equipment. A seemingly satisfactory compromise has been reached by at least one maker of a light truck, who employs solid tires at the rear wheels, where the wear caused by the tractive effort is greater, and pneumatics in front, where the weight distribution is less, and where the motor may be partially insulated from many of the excessive shocks of high-speed travel.

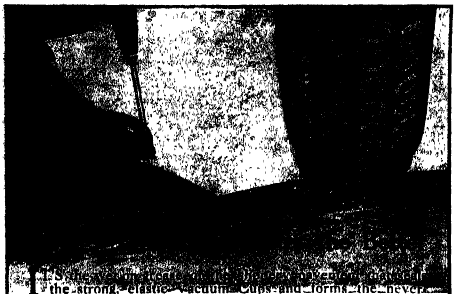
M. A. L. writes: "One of the cylinders of the motor in my three-ton truck has suddenly lost its compression-retaining ability, and, therefore, does not deliver its full share of the power. The garage man tells me that the rings have probably worked around so that the opening of each is opposite that of its neighbor. Please tell me how this may be accounted for and how a repetition may be prevented."

A. We assume that there are three rings on the piston in question. When the motor is assembled, the opening of each ring should be opposite the "back" of the one adjacent to it. That is, if the first ring is set with its opening toward the front of the motor, the second should be placed so that its opening faces the rear of the motor; the third ring, in turn, will then face forward. The rings should be held in these relative positions by notches in the edge of their open ends that fit into pins set into the proper places in the ring grooves of the piston Insamuch as the openings of the first and third rings are in a line with each other, it is only necessary that the middle ring be moved out of place half a turn, or 180 degrees, before a free path for the escape of the gas in the cylinder will be furnished To be sure, it is seldom that the ring can "ride" up on its pin, and yet through a faulty installation, several instances of this have been known to occur. The remedy lies in reinstalling the ring in its proper position, or in the use of a type of ring that has no free opening for the escape of the compressed gas. This latter type is really two rings in one. These are mounted concentrically, with the flanged edge of one overlapping that of the other so that both the outside and inside present a smooth surface. Each of these two rings has its own notched opening, but as this rests firmly against either the inside or outside surface of its companion ring, the device is elastic and flexible without affording a single break in the contour of the ring as a whole

P. W. H. writes: "My truck is equipped with single, four-inch solid tires. As the frame and motor seem to be easily capable of carrying nearly double the rated load, and as I understand that overload injures the tires more than any other part of the truck, could I increase the carrying capacity of the truck one hundred per cent by replacing my rear wheels with those having dual rims on which twin four-inch tires would be used?"

A. While it is true, as you say, that the tires are the principal sufferers from overloading, nevertheless, the motor and transmission may be harmed by such a practice, and we would strongly urge you to keep the average loads of your truck well within the limits set by the manufacturer Furthermore, it is not considered that two tires of a given size will carry double the load for which a single tire of the same size is suited For example, if a four-inch tire can support a thousand-pound load without difficulty, it is assumed by conservative manufacturers that four-inch dual tires will carry fifteen hundred pounds with the same margin of wear. This allowance is made to provide for the times when one or the other of the dual tires will carry the entire load of that wheel, as, for instance, when the truck passes over a stone or a rut that comes in contact only with one of the dual tires.

The Crozet Islands, in the southern Indian Ocean, have been annexed by France. They are uninhabited and are rarely visited, though they lie near the route between Cape Town and Melbourne. The "Gauss" Antarctic expedition paid a visit to the islands in 1901.



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RECENTLY PATENTED INVENTIONS

These columns are open to all patentees The notices are inserted by special arrangement with the inventors Terms on application to the Advertising Department of the Scientific American

Pertaining to Apparel.

ADJUSTABLE SHOE BUCKLE FASTENER.—C. M Bonham, 2184 Seventh Ave., Manhattan, N. Y, N. Y This invention relates to shoe buckles or ornaments adapted to be used particularly in connection with pumps, although it is not limited exclusively to this application, and the invention has to do more especially with fastening or attaching devices for buckles or other ornaments.

STORM SLEEVE—H. Hertz, 115 E. 96th St., New York, N. Y. This invention provides a garment having sleeves for coats adapted particularly for chauffeurs or other drivers, and having the appearance of ordinary sleeves provided with outer cuffs, but in another adaptation providing effective hand coverings, keeping out wind, snow, or rain, the arrangement being such in the latter adaptation as to completely exclude the elements.

Of General Interest.

COMBINED CHAIR AND BASKET—B. H. Goldstein, care of J. Cohnen & Bros, 223 Cherry St., N Y, N. Y. This invention relates to improvements in combined chairs and baskets, and has for an object the provision of an improved structure which will afford a seat for an operator and a suitable convenient receptacle for the operator's work.

MONOCLE AND THE LIKE—H. T. Louch, 65 Hatton Garden, London, E. C England. This invention relates to monocles, magnifying lenses and the like, which are usually held in position by contraction of the muscles in the neighborhood of the eyes, the object of the inventor being to devise such improvements as will enable the articles to be held in position while at the same time conducing to the comfort of the wearer without impairing the efficiency of the device, or rendering it unsightly

STILL.—C L. Turner, 180 Madison Ave, Tompkinsville, N Y. This invention provides a still wherein fractional and continuous distillation may be performed, provides a still for the production of fractional distillation of hydro-carbon oils or other volatile liquids, provides means for conserving the heat employed in the distillations; and provides means for increasing the output of stills adapted for practical distillation

Hardware and Tools.

KEY RING LOCK—D C. En Earl, Hotel Colorado, 1634 Larimer St., Denver, Colo The purpose here is to provide a lock which is in the nature of a puzzle that may be readily operated by one who understands the construction and purpose of the lock, but which is exceedingly difficult to open by one who does not understand the operation

VALVE GRINDING TOOL—H. R. Parsons, Sharpsville, Pa The invention pertains to valve grinding tools utilized to grind in valves on automobile motors and other mechanisms where valves are used, the object being to provide a tool having means to engage a valve, and also provided with means whereby the operator may readily and conveniently press downwardly upon the same and rotate it at the same time, utilizing both hands in part performance of each operation

DEVICE FOR OPENING ELLIPTICAL SPRINGS.—C N Sowden Guantanamo, Cuba This invention relates to a device to be applied to laminated or leaf springs, such as elliptical or semi elliptical springs, and more particularly refers to that form of device for the indicated purpose, in which opposed wedge members have relative movement toward and from each other, to be entered between the leaves of the spring and withdrawn therefrom

Heating and Lighting.

SAFETY VALVE—H Steinberg, Huntingdon, Pa. This inventor provides a safety valve for attachment to a hot water boiler, especially those connected with stoves and ranges, which will serve the purpose of permitting the escape of excessive steam pressure when the water reaches a boiling point, thus obviating explosions which commonly occur.

Household Utilities.

FOLDABLE GAS STOVE.—R S Way, 415 No Grand, Los Angeles, Cal This stove is adapted to be folded into a casing set in a recess in a wall, to take up little room and not detract from the appearance of the apartment, to allow of easily unfolding the stove for use, and to automatically shut off the gas supply when folding it into the casing or to turn on the gas supply when moving the stove into extended position.

SANITARY GARBAGE RECEPTACLE—S I Segall, 2018 83rd St, Brooklyn, N Y This invention has reference to storage receptacles designed to store garbage, trash and the like, and has for an object to provide an improved structure which will automatically close itself after each time the same is opened

CURTAIN CLASP.—W H. Wallin, Box 5, R F D No 2, Stromsburg, Neb This improvement relates to devices for clasping a curtain on a curtain pole to prevent the curtain from bunching and to maintain it properly draped It provides a clasp having effective gripping engagement with a curtain, and one capable of a great variety of ornamental effects.

Machines and Mechanical Devices.

APPARATUS FOR TAKING OR REPRODUCING ANIMATED PICTURES.—L. H. Hurt, 114 Rue du Temple, Paris, France. The present invention has for its object a special operating device obviating numerous disadvantages. By reason of its special combination, this device puts kinematography within reach of the public and enables photograph amateurs to take successively several animated scenes without being compelled to go in a dark room for substituting a plate for another one in the photographic apparatus.

TANK SIPHON.—P. Balze, 200 Christie St., Leonia, N. J. This invention relates to water distribution, and has particular reference to siphons for periodically delivering fluids, especially water, from tanks Among the objects is to provide a siphon adapted especially for flush tanks, the nature of the siphon being such that it is valveless and hence precludes any possibility of leakage.

PROJECTING APPARATUS FOR MOVING PICTURE MACHINES.—G. E. Ripley and W. N Gladson, Fayetteville, Ark., and R. E. Thompson, Heber, Ark. Address the second, care of University of Arkansas, Fayetteville, Ark. The invention is an improvement in projecting apparatus for moving picture machines, and has in view a reflecting mechanism to cause the image of one picture to dissolve into the next without employing a tinted or softening light, or otherwise lessening the brilliancy of the screen during the picture change.

MACHINE FOR CUTTING BREAD.—E. Schmidt, Geb. Walter, Berlin-Tegel, Germany. This invention relates to a machine for cutting bread It is provided with a knife adapted to operate like a lever, the loaf of bread to be cut being placed on a grid consisting of rods, which, when the machine is in use, are at right angles to the knife The ends of the rods are secured to standards, to one of which the knife is pivoted

Railways and Their Accessories.

CAR FENDER—J. P Geraghty, 50 Hamilton Place, Jersey City, and G. W. Naylor, Jersey City, N. J. The invention provides a fender more especially for use on surface cars and arranged to normally hold the apron frame a distance above the track to clear switches, paving stones, etc, to cause the apron frame to move in an inclined position on a person or other object falling onto the track, and being struck by the gate, and to immediately cause the apron frame to swing back into normal position as soon as the person or object passes onto the apron frame, thus preventing person or object from being run over or injured by preventing a hand or foot from passing under the apron frame.

Pertaining to Vehicles.

SIGNALING APPARATUS—E. D. Lopez, New Orleans, La., care of Elite Letter Co., 41 W 33rd St, New York, N. Y. This device is for use on automobiles and other moving vehicles, and the object of the invention is to enable the driver to give notice to the car behind whenever he intends to stop or turn, without necessitating the removal of the driver's hands from the brakes or steering gear when the operation of stopping or turning is to be effected.

ACTUATING MEANS FOR SWIVEL LAMP HOLDERS—C. N. Sowden, Guantanamo, Cuba. This invention relates to lamp holders for automobiles, locomotives, and other vehicles having means for automatically turning the holder in the direction in which the vehicle is turned, and manually controlled actuating means. It refers more particularly to lamp holders and their appurtenances of the character forming the subject of the application filed by Mr. Sowden, Serial No. 728,970

AUTOMOBILE FENDER.—J. B. Foret, 633 Biddle Ave., Ford City, Mich. By means of this device a person who happens to be in front of an automobile may be prevented from suffering injury by the vehicle The fender has a grab rail, which may be seized and which tends to cause the lifting of the outer portion of the fender, thereby removing the person's clothing from the ground and preventing it being caught between the fender and the ground.

Note—Copies of any of these patents will be furnished by the Scientific American for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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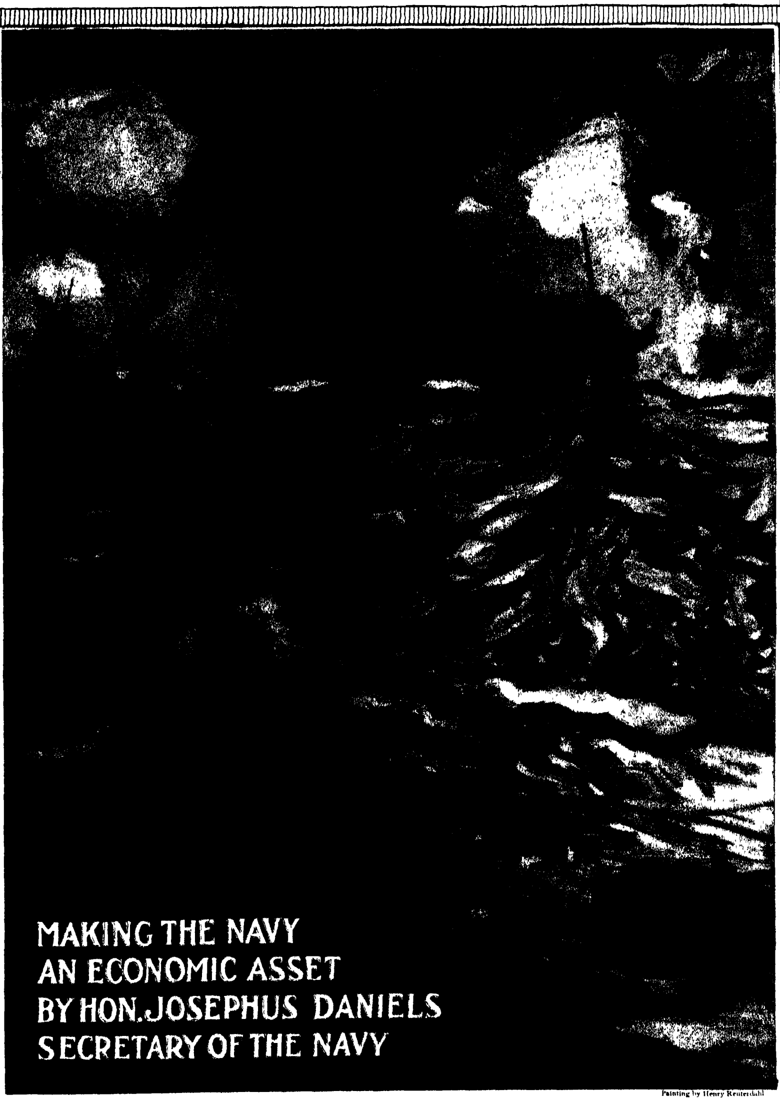

MAKING THE NAVY AN ECONOMIC ASSET

BY HON. JOSEPHUS DANIELS SECRETARY OF THE NAVY

Painting by Henry Reuterdahl

Vol. CX. No. 18
May 2, 1914

Munn & Co., Inc., Publishers
New York, N. Y.

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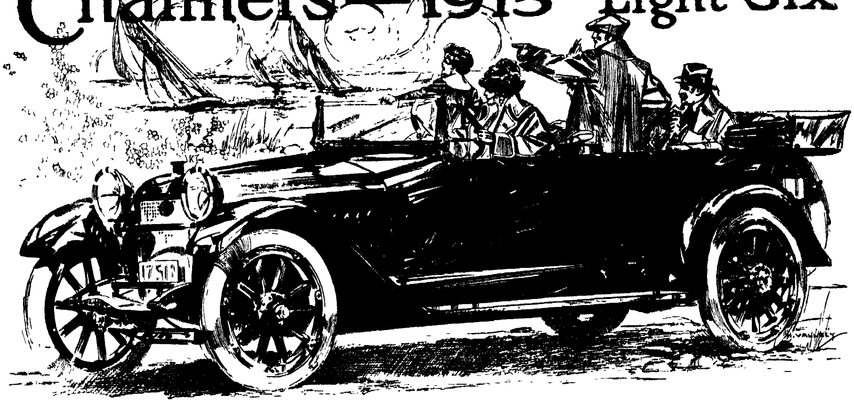
Chalmers—1915 "Light Six"



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The Master "Light Six" is a full year ahead; in style, in mechanical design, in simplicity, in efficiency. That's why thousands who once thought a "Six" an extravagance are now ordering 1915 Master "Light Sixes" faster than we can build them.

A "Six" or Nothing

This is the car for which thousands who would have a "Six" or nothing have waited.

The 1915 Master "Light Six" offers for the first time the full measure of 6-cylinder silence, smoothness and flexibility at the price of any comparable "four."

The Master "Light Six" at $1800 makes it unnecessary now to pay a high price, or a high maintenance cost to get six-cylinder luxury.

This 1915 Chalmers answers the last arguments of the four-cylinder builders —those of price and economy.

A Lighter Master "Six"

What the Chalmers Master "Six" at $2175 is among high powered cars, the 1915 "Light Six" at $1800 is among cars of its class. It has the same Master Motor, though built on a lighter scale. It has small bore and long stroke to give it flexibility; perfect balance to give it smoothness; right design to give it silence.

Its Chalmers-Entz electric starter makes the motor non-stallable. Tapered bonnet, oval fenders and streamline body rank it with the expensive foreign cars in looks.

Its lighter weight means an added economy. Yet it is heavy enough to make it safe in any emergency, comfortable on any road. Don't make the mistake of buying too light a car. The difference in gasoline consumption between a medium weight car and a flimsy car won't amount to $25 in 10,000 miles, and $25 won't buy many repairs for a car so light that it shakes to pieces in ordinary service.

Like all Chalmers cars, the 1915 "Light Six" is built to give satisfactory service through many seasons.

Buy This Car for Economy's Sake

Men want silence for its charm, smoothness, for its comfort, and flexibility for its convenience And they want these six-cylinder qualities, too, because they make motoring nerve soothing, not irritating You can drive a Chalmers "Six" 200 miles and be less fatigued than after 100 miles in a "four." Forty miles an hour in a "Six" doesn't give the nerve rasp of 25 miles in a constantly vibrating "four"

Men want these qualities for economy also. They know that vibration means needless strain on gears and bearings as well as nerves; power wasted in joggling the car instead of driving it.

They know that absence of noise means absence of undue friction; that a flexible motor means an economical motor. They know that only a "Six" can have these qualities So they buy the 1915 Master "Light Six," for its economy as well as for its charm.

A Car of Super-Value

It is hard to believe that any car at $1800 could possess all the advantages we claim for the Master "Light Six." Until you see it, you cannot realize its distinguished beauty; until you ride in it, you can know nothing of the extraordinary value it offers at the price.

When we say the 1915 "Light Six" is a year ahead of others, we mean just what we say

In design, in luxury, in endurance, in good looks we believe this to be the most advanced "Six" on the market. It has today the features of construction and equipment which most cars in the $2000 class will not have for another year

So we urge you to take the Chalmers Test Ride with our nearest dealer. Let the car itself prove its super-value.

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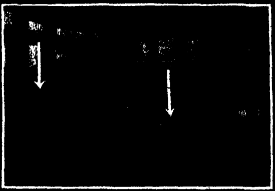

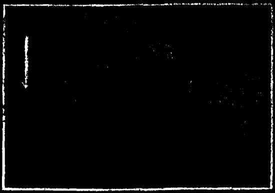

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So far as design and years of service are concerned, the factory that buys a Westinghouse installation buys the *Westinghouse name*—a name which has been associated with important electrical developments ever since the Westinghouse Electric development of the alternating current.

It buys an organization which covers the country with offices and service stations. In short, it adds to your factory a complete engineering organization, one with a world-wide reputation.

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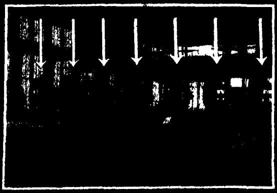

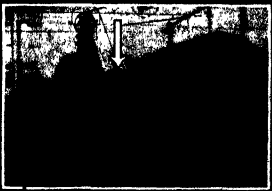

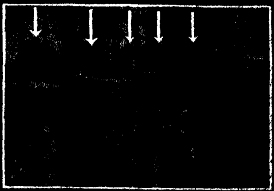

SEVENTIETH YEAR

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NEW YORK, MAY 2, 1914.

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The Problem of the Hudson River

How the Model Experimental Basin and the Moving Picture Machine Solved It

By Robert G. Skerrett

THE United States model experimental basin at Washington has recently performed a new service; it has helped the Government authorities to solve some of the vexed questions relating to the matter of pier extensions into the Hudson River. This it has done by reproducing in miniature the physical peculiarities of the dock encroachments and the tidal prisms of the North River, more especially at that section between Castle Point on the New Jersey shore and the Chelsea section of the New York city piers.

The army engineers and the experts of the Dock Department of the metropolis could not agree on the probable effects of further extensions to the Chelsea piers. The army engineers believed that further encroachments upon the flow of the river would cause serious perturbations and probably increase the velocity of the tidal movements. The city authorities wanted to build longer piers within the narrowed section of the river in order to accommodate 1,000-foot liners. The river was already but 2,800 feet wide navigably.

It was, therefore, urged that tests be made at the tank in Washington, and Naval Constructor D. W. Taylor and Col. H. C. Newcomer set about devising facilities and planning suitable models for this exceptional undertaking.

The army engineers had more than an inkling of the need of just such an investigation, for the history of the river during a number of decades told a convincing story of what the building of piers, the reclaiming of considerable areas of land along the shores, and the increased traffic had wrought in the interval. From 1858 to 1912 the velocity of the ebb tide had increased 60 per cent at that section just north of the Chelsea region, while immediately south the corresponding normal outgoing tide had gained in rapidity a matter of 87 per cent! As the "bottle-neck" lying between the Chelsea piers on one side and Castle Point on the other had narrowed the while, this means an ebb velocity of quite 4.08 miles an hour.

These changes have imposed a heavy tax upon river traffic, and especially upon tugs with tows and, prospectively, upon self-propelled canal boats—the speed of the latter within the canals being limited to four knots an hour. Hence, these boats would have to add greatly to their engine power for the single purpose of navigating a very small section of the river when trying to work up stream against the ebb. This was not all. These changes in the speed of the tide had well-nigh put a stop to all heavy towing in that part of the river during the periods of greatest current velocities In short, the bulk of the lightering and barge work had to halt until the sweep of the tide slackened. A heavy handicap upon harbor traffic was imposed.

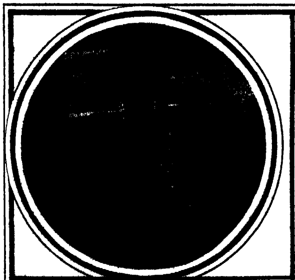
Because of the dangerous and disastrous forces exerted by suction between ships within "constricted waterways," Col. William T. Rossell, as senior member of the Harbor Line Board, urged that experiments be made in the naval tank at Washington not only to discover the possible effects of further narrowing of the river by pier extensions, but to study the perturbations set up in the water by the movements of incoming and outward bound liners when passing other craft or when flanking the open ends of docking spaces where other vessels were lying. Col. Rossell believed that these great express steamers seriously disturbed the river's normal sweep for considerable distances on either beam, and that these forces might constitute a serious menace to river traffic and to the vessels tied to the piers

The basin at Washington was provided with a false bottom resting upon heavy steel I-beams, and the simulation of the width and depth of the river was upon a scale of 15/1,000. This false bottom was painted a solid color and then marked conspicuously by cross-lines which cut the reflecting surface into numerous squares Attached to the underside of the towing carriage was a large mirror, at an angle of 45 degrees to the water, which reflected the false bottom, and made it possible for a moving picture camera located 75 feet in advance to take photograph of the changing view. Anchored over this false bottom were small aluminium buoys, to which were attached vertical rods the positions of the tips of these rods at or below the surface being nicely controlled. The tips of these rods represented, for the time being, imaginary particles of water, and the aim was to trace the beginning, the directions, and the amplitude of their movements when disturbed by the subsurface perturbations set up by the approaching, passing, and retreating model as it was towed by the carriage. At the same time, a large dial on the carriage indicated the position of the model on its course, the face of the dial being divided into elements of the length of the miniature channelway

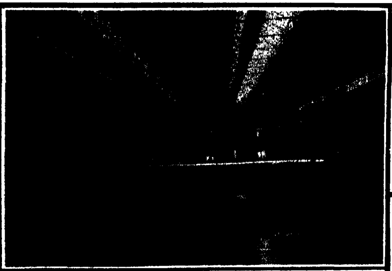
Two models were provided for the experiments, one 15 feet long, representing a 1,000-foot liner, and the other 10 feet long, standing for a ship of the same shape, but only 666.6 feet over all The larger model was equipped with twin screws driven by an electric motor within the craft, and when running in this fashion the mission of the carriage was merely to guide its course. The object of this novel departure in tank experiments was to determine whether or not the action of the screws added materially to the force and zone of the water disturbances The smaller model was placed alongside the piers to test the effects of the passing of the miniature 1,000-foot liner, and above the 10-foot model was suspended a screen by means of the cross-lines of which the camera could record the resulting movements The 15-foot model was towed or run at four different speeds to represent a 1,000 foot liner moving at the rates of 6, 10, 15, and 20 knots an hour The equivalent actual speeds on the part of the model were respectively, 0.735, 1.23, 1.84, and 2.45 knots It was found that there was remarkably little difference in disturbance when the model was towed or when

(Concluded on page 378.)

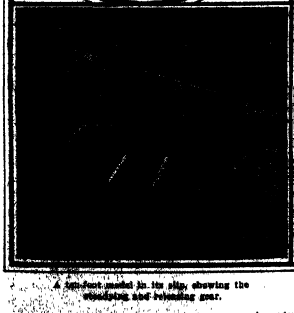
Projecting lantern and view on the screen.



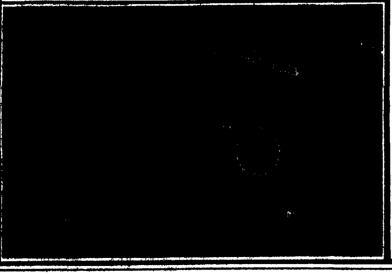
The large 45-degree mirror and the magnet frame



Enlarged view on the screen



A ten-foot model in its slip, showing the steadying and releasing gear.



Ten-foot model, mirror, and scale. This model stood for a ship 666.6 feet long. It showed how large liners affect smaller vessels.

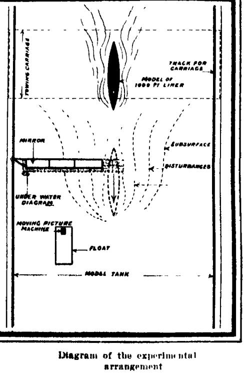


Diagram of the experimental arrangement

Ascertaining the effect of large liners on the shipping in the Hudson River.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement

Once More the Anti-vivisectionists

A VERY ingenious German once wrote a bitter book called "A History of Human Stupidity." In it he chronicles many delectable examples of medieval superstition, which retarded the progress of the world by centuries, as well as numerous examples of modern asininity. He holds up to ridicule not only the foolish way in which science was retarded by religious persecution in the middle ages, but also such supremely foolish acts as that of a European peasant who buried himself alive in order to escape the census-taker.

Some day that "History of Stupidity" will be amplified. Its most distressing new chapter will be devoted to the anti-vivisection mania which threatens to strangle scientific research, of whose inestimable benefit to humanity there cannot be the slightest question. In this campaign which ignorance, fanaticism and sentimentality have waged against humanity, surely the pinnacle of absurdity was reached when the bill to permit the Rockefeller Institute to establish a research laboratory in the State of New Jersey for the study of animal diseases and their cure was vetoed by Governor Fielder. One million dollars have been contributed by Mr. Rockefeller for research work on animal disease—research which is surely of vast importance when it is considered that our annual loss through the sickness of domestic animals amounts to one hundred million dollars for cattle alone and about seventy-five million dollars each for hogs and sheep.

Any one who has followed the proceedings of the recent medical congress in New York, an occasion upon which the most distinguished surgeons and physicians published to the world the progress which has been made in recent times in alleviating human suffering, must have been impressed with the high ideals of those who experiment upon animals in order to discover new methods of curing disease. If we are to credit the anti-vivisection ravings it might be supposed that the members of the Rockefeller Institute and similar institutions have no other object in mind than to obtain some devilish enjoyment by torturing guinea pigs, rats, and dogs. Of the great personal risks that these men run in handling deadly bacteria, of the weeks and weeks of patient experimenting, of the tragedies and martyrdoms of medical science, one hears nothing.

A score of medical men who could ill be spared have perished as a result of their special work in the field of X-rays. In his sixty-fifth year Dr. Robert Koch, the father of preventive medicine, remained for eighteen months on one of the Sese Islands in Victoria Nyanza, fighting incessantly with mosquitoes and ants and enduring "impossible food." With only one white companion, an army surgeon, he braved fevers and epidemics until at last he discovered crocodile's blood to be the chief nourishment of the tsetse fly, the voracious insect which transfers the trypanosomes, the specific cause of the sleeping sickness. Anti-vivisectionists would do well to read that wonderful letter which Koch wrote to his friend, Dr. Libbert, in which he says: "The flies engage our attention less than their victims. What a wonderful privilege it is to be able to save human beings who are doomed to certain death! It is this that makes it a real joy to be a physician."

What have anti-vivisectionists to say of the labors of Shiga, Ross, and Manson, men who have worked in daily contact with the deadliest toxins, all for the purpose of making the tropics and above all infection-ridden India tenantable by white men. And what shall be said of that committee of medical men which in 1900, in order to investigate the theory of Dr. Finlay that it was a mosquito which conveyed to human beings the germ of yellow fever, cheerfully volunteered to run the risk of subjecting themselves to the bite of the yellow fever mosquito? Surely war can display no finer heroism than this, and surely men who can make such great sacrifices can not be guilty of wanton cruelty to the lower animals.

Economy of the Modern Steam Engine

THE economies which have been secured in steam engine practice by the introduction of the steam turbine are strikingly illustrated in the installation which is being emplaced at the power station of the Interborough Rapid Transit Company, East River and Seventy-fourth Street, New York city, where the three largest turbines in the world are being built by the Westinghouse Company for the operation of the new subway. The turbines will supply sufficient electric current to operate 135 fully loaded ten-car trains accommodating 135,000 people. They are of the cross compound type, and consist of two sections, a high pressure and a low pressure unit. The high pressure unit will receive steam at 200 pounds pressure, and will drive a direct-connected generator running at 1,600 revolutions. The exhaust from the first unit will be utilized by a larger, low pressure unit, running at 750 revolutions per minute. From this the steam will pass to the condenser. Each turbine will be direct connected to a dynamo which will deliver 30,000 kilowatts, or about 41,000 horse-power; and, at full overload, each machine can deliver 36,000 kilowatts, or practically 50,000 horse-power, for a short period of time.

The economies of the turbines, as compared with the existing reciprocating engines, are many and very large. The turbines occupy less space, weigh less, effect a large saving in lubricating oil, and call for a smaller operating staff. Thus the new turbines will require about 1,645 square feet of floor space, representing an area measuring 31½ feet by 52 feet, and this is about the same as that occupied by the original reciprocating engines installed in 1901, which were illustrated at the time in the SCIENTIFIC AMERICAN. But although the space occupied is the same, the total output of power will be four times as great as that from the old plant.

The amount of steam used, and the enormous amount of cooling water required for the condensers, afford figures that are positively astonishing to the layman. Each unit will use about 350,000 pounds of steam per hour, and to condense this steam so that all the benefits of a vacuum may be obtained in connection with the low pressure unit, each turbine must be provided with a condenser containing 50,000 square feet of cooling surface. To insure this the condenser will contain 36 miles of brass tubing one inch in diameter. The necessary amount of cold water for circulation through the tubes will be drawn from the East River, and through each condenser there will be passed every hour 4,500,000 gallons of water. To pump this amount of water through the condensers for the eight units which will be ultimately installed calls for a tunnel 12 feet 4 inches wide and 12 feet 4 inches in height.

The saving in the coal bill by the use of turbines is truly remarkable. In the old cross compound reciprocating engine only 17½ per cent of the heat evolved by the combustion of the coal was turned to practical use, or as the engineers say, the thermal efficiency was only 17½ per cent. Moreover, 17 pounds of steam had to be consumed to deliver one kilowatt of power for one hour. With the new cross compound turbines a kilowatt of power will be secured on a consumption of 11¼ pounds of steam per hour. Under the present operating conditions 300,000,000 gallons of water are turned into steam every year for the use of the reciprocating engines. The new turbines will do the same work on 200,000,000 gallons of water with a corresponding reduction in the amount of coal that must be burned on the grates of the boilers.

The Mexican Navy

MEXICO is not entirely devoid of a navy. In fact, she possesses seven fighting ships, possibly four or five transports, and, for harbor service, she has three old schooners built by that Laird firm which was responsible for the armed cruisers which gave the North so much trouble during our civil war. The largest vessels of her little fleet are two cruiser transports, the "General Guerrero" and the "Progresso." These are modern ships, the first built by Vickers, Maxim, in 1908, and the second by Odero, in 1907. The "General Guerrero" is a vessel of 1,880 tons, armed with six 4-inch guns and two 3-pounders. Her engines of 1,200 horse-power give the ship a speed of 12 knots. The "Progresso," of 1,600 tons, is a single-screw ship of 14 knots, armed with four 4-inch rapid-fire guns.

Next in size to these are four gunboats. The "Bravo" and "Morales," built by Orlando, in 1903, are sister ships of 1,200 tons displacement, carrying a complement of 150 officers and men. They were designed to steam at 16 knots with 2,600 horse-power, and each is armed with two 4-inch rapid-fire guns, six 6-pounders, and with one 14-inch torpedo tube carried above the water line. These are twin-screw gunboats, and each carries about 200 tons of coal. The other two gunboats are the "Tampico" and the "Vera Cruz," built in 1902 at Elizabethport, New Jersey. Each is of 980 tons displacement, and the complement of officers and men is 98. They can steam 16 knots with 2,400 horse-power, and the armament consists of two 4-inch rapid-fire guns and six 6-pounders, with one 14-inch torpedo tube in the bow above the water.

The other vessels are obsolete, the most important being the "Zaragoza," built in 1891, and rebuilt in 1910. She is of 1,200 tons displacement and steams at a speed of 15.5 knots. Her armament consists of six 4.7-inch, rapid-fire, Schneider-Canet guns. The navy is also credited with a transport, the "Oaxaco," and possibly three or four others. The harbor service vessels are quite negligible, being nearly forty years old.

Mercury and X-Rays

RESEARCHES have recently been made by Landau and Piwnikiewicz on the phenomena of luminescence produced by X-rays acting on mercury vapor, particularly as regards the relation between the luminescence and the nature of the rays. The luminescence of mercury does not occur except at high temperatures. On making a vacuum in a glass vessel containing mercury and heating it and exposing it to the X-rays, an intense bluish green fluorescence is observed. Appropriate diaphragms permit one to limit the sheaf of rays, and, in consequence, the luminescent surface. The authors observed that the fluorescence is accentuated as one increases the density of the vapor, while the addition of foreign gases diminishes the intensity of luminescence, of which the emission spectrum is continuous. The authors explain these phenomena as follows: The energy of the X-rays being absorbed by the vapor, the increase of intensity resulting from an increase in density is easily understood. The atoms of mercury emit secondary kathode rays, to which the strong ionization is due. Now, the presence of a lighter foreign gas causes these secondary kathode rays, by successive molecular shocks, to pass, for preference, across the lighter gas, which necessarily enfeebles their effect upon the molecules of mercury.

Kathode Rays and the Tail of Comets

FOR some time the luminosity of cometary appendages has been attributed to electrical phenomena analogous to those which take place when a tube of rarefied gas is traversed by an electric discharge. But this rather vague explanation took the second place when Arrhenius came forward with the theory that the tails of comets are due to the pressure of radiation from the sun. But another explanation has been offered recently which is, from some points of view, more satisfactory. The nucleus of a comet is regarded as a permanent source of electrons which are projected into the cometary atmosphere. If now the electric field of the sun is centripetal, the luminous effects, due to the projected electrons, should be localized in the direction opposed to the sun. From researches made on the magnetic field of the sun, and applying the theory of Schuster, which attributes the magnetism to electric charges carried round by the sun's rotation, it appears that the dominant electric charge on the sun should be negative, which results in a centripetal electric field; thus, the above hypothesis accords with the most recent discoveries.

The Degeneration of the Arab Horse

THE Arab horse, a race which has been all-important in the development of the most valuable equine breeds of the present day, is said to be deteriorating in quality and diminishing in numbers in its original home, owing to changing habits of the Bedouins and increasing exportation. The *Philippine Agricultural Review* states that as a step toward preserving this famous breed there is being formed in Cairo an International Horse Society. The first work of this society will be to start a studbook, one part of which will include only pure-bred horses of desert origin, while the other will be open to all so-called "eastern" horses; i. e., horses bred in the near East, but having an infusion of alien blood. Pure-bred Arabians are now found only among the different Bedouin tribes of the Arabian and Syrian deserts (in Mesopotamia and the Nejd); in a few private studs in Egypt; and in a very few European and American studs. The society will hold annual shows and auction sales at which will be offered animals of certified purity of pedigree.

Kerosene Motor Competition Postponed.—The kerosene motor competition, which was to have been started by the Automobile Club of France, Paris, on October 1st next, has been postponed. It will take place commencing November 15th.

Engineering

Four One-Thousand-Foot Drydocks Built and Building.—There are now four drydocks of 1,000 feet in length built or under construction. The Gladstone Dock, 1,000 feet long, has been completed at Liverpool. Another is being built at Quebec, and a third at Boston. Last month the Hughes drydock at Bombay, India, 1,000 feet long, 100 feet wide, with a depth of 30¼ feet, was opened.

Lives Saved by Street-Car Wheel-Guards.—The Public Service Commission states that recently, in three days, eleven persons were run down by street cars, and that ten of them were saved by the operation of the wheel-guards. These guards were installed by order of the Commission, and their saving of human life has been proved time and again. In one case two boys were picked up together; at another time an elderly man was saved from passing under a car, with no greater hurt than a few bruises.

Subway Carries Two Billions Without a Fatality.—The Interborough Rapid Transit Company, which operates the New York Subway, points with justifiable pride at the fact that the present subway has transported 2,198,000,000 persons in the last nine years without a single passenger fatality, and this in spite of the fact that the speed and frequency of this train service is unsurpassed in work of this character. The subway is undoubtedly the most efficiently operated railway system in the world, and there is no doubt that this wonderful record for safe travel is, on the mechanical side, mainly attributable to the efficiency of the automatic stop.

Demolition of the First Sky Scraper.—There has recently been demolished, to make way for a larger structure, a ten-story tower building, at 60 Broadway, New York city. The building was erected in 1889 and has been in service for a quarter of a century. Naturally the condition of its framework was a matter of interest for architects and engineers. The frame consisted of cast iron columns and wrought iron floor beams. The floors were of flat-arch, terra cotta construction. The framework was found to be in excellent condition, the wrought iron beams showing a practical absence of rust, and the cast iron columns, with a three-inch cast iron shell around them for fire protection, showing only a few localized patches of rust and heavy rusting only at a few special points.

Reconstruction of the Lachine Bridge over the St. Lawrence.—The once notable Lachine Bridge of the Canadian Pacific Railway over the St. Lawrence River near the Lachine Rapids, about seven miles above Montreal, has recently been renewed and double-tracked. The old single-track bridge, built in 1885-1887, consisted of two channel spans, each 480 feet long, and deck spans 80 to 270 feet long. An interesting feature of the channel spans was that they were connected to the adjacent 270-foot spans by curved connecting chord-pieces, thus making the four spans continuous. The old bridge was designed for a loading which was only about one half of the train load for which the new bridge has been designed—an eloquent commentary on the rapidity with which the weight, power and capacity of our freight train service has increased in the last quarter of a century.

The Beaufort Scale of Wind Velocity.—The Weather Bureau, which is under the United States Department of Agriculture, has announced that on and after April 1st it will utilize the Beaufort wind scale to designate the velocity in all wind forecasts and storm warnings. The Beaufort scale as thus announced is as follows:

Force.	Destination.	Miles per Hour
0.	Calm.	From 0 to 3
1.	Light air	Over 3 to 8
2.	Light breeze	Over 8 to 13
3.	Gentle breeze	Over 13 to 18
4.	Moderate breeze	Over 18 to 23
5.	Fresh breeze	Over 23 to 28
6.	Strong breeze	Over 28 to 34
7.	Moderate gale	Over 34 to 40
8.	Fresh gale	Over 40 to 48
9.	Strong gale	Over 48 to 56
10.	Whole gale.	Over 56 to 65
11.	Storm	Over 65 to 75
12.	Hurricane	Over 75

A Movement for Good Roads.—The American Highway Association and the American Bar Association have inaugurated a movement to remove from the statute books of various States, ancient and obsolete road laws which have been on those books more than one hundred years. The first step in the revision of the State road laws would be to recommend that all obsolete and unnecessary laws be rescinded. Certain basic features of good administration will be urged by the joint committees, such as payment of road taxes in cash, elimination of unnecessary officials, the requirement of skilled supervision in construction and maintenance, constant employment of highway engineers, the substitution of appointed for elected officials and the substitution of continuous maintenance for the present intermittent methods.

Science

A Statue of Dr. E. A. Wilson, who perished with Capt. Scott in the Antarctic, is to be unveiled some time next July at Cheltenham, England, Dr. Wilson's birthplace. The statue is the work of Lady Scott, and the unveiling ceremony will be performed by the veteran explorer Sir Clements Markham.

Phosphates in Egypt.—We learn from the *Bibliothèque Universelle*, that vast deposits of phosphate have recently been discovered in the valley of the Nile, on the coast of the Red Sea, and in the oasis of Dakhla. They are composed of fossils and contain impurities consisting chiefly of silica and various salts of iron. The largest beds are at Dakhla, and have a thickness of 2-3 meters, with a width ranging from 4-5 meters to a kilometer and a half.

The International Seismological Association will hold its third general meeting, coincidently with the fifth conference of its Permanent Commission, at St. Petersburg, early in September, under the presidency of Prince Galitzin. The preliminary programme, just distributed, shows that among the principal topics of discussion will be terrestrial tides, together with related questions, such as the elasticity of the earth's crust. A somewhat novel field of discussion will embrace the various possible relations of earthquakes to electrical and magnetic phenomena.

Explosive Dust in Mills.—The engineers of the U. S. Bureau of Mines have, during the past year, investigated every mine coal-dust explosion in which more than two lives were lost. As an auxiliary line of investigation the Bureau has undertaken a study of other inflammable dusts. One investigation related to a grainmill explosion at Buffalo in which 33 lives were lost, and a co-operative arrangement has now been made with the National Milling Association for carrying out further studies of inflammable dust in mills, the cost of the work to be borne by the association.

Lessening Fatigue.—It is well known that it becomes fatiguing to carry a heavy weight in the hand, such as a valise, for any considerable distance, especially because it hinders the movement of the lower limbs. A Frenchman has found a way to prevent this inconvenience, which is as simple as it is practical, and all that is needed is to put under the arm a bulky packet, which is made up of a dozen newspapers folded together. In this way the handbag is far enough removed from the legs so as not to hinder walking with ease. He says that the fatigue is much less and the weight appears to be lighter.

Hailstorm Insurance.—Statistics for the year 1911, recently published, show that the custom of insuring crops against hail is much more prevalent in Germany than in any other country. The total amount of hailstorm insurance carried in Germany in that year was $825,000,000, as compared with the following amounts in other countries Austria-Hungary, $202,500,000; France, $193,750,000; Italy, $100,000,000, Roumania, $100,000,000; Argentina, $62,500,000; Denmark, $55,000,000; Sweden, $25,000,000; Russia, $20,000,000; Switzerland, $15,000,000; Netherlands, $7,500,000, Spain, $5,000,000; Belgium, $2,500,000; Bulgaria, $1,250,000. In Bavaria, Austria-Hungary, Bulgaria, and the Canadian province of Alberta this form of insurance is conducted by the government. The premiums for hailstorm insurance are supposed to be based upon the average frequency of hail, and upon the kind of crop insured; some regions being much more subject to hailstorms, and some crops much more susceptible to their effects, than others. In parts of Italy, premiums up to 5 or 6 per cent are paid, while in Argentina they reach 10 or 12 per cent.

The Sanitation Service of Porto Rico, which was organized in 1911, has recently been much improved through the establishment, by the Porto Rican Legislature, of an Institute of Tropical Medicine and Hygiene, the president of which, Dr. W. F. Lippitt, is also director of sanitation in the island. One of the first undertakings of the Institute was to organize a school for sanitary inspectors, in order to provide a properly trained personnel for the sanitary service. To this school were brought last year those young men employees of the service who, by zeal and attention to duty, had shown themselves worthy of promotion and permanent employment, and the classes were also thrown open to non-employees, with the understanding that those who passed the examination would be given preference in future appointments to the service. Graduates of the school are already doing efficient work in various parts of the island, where previously no persons having any knowledge of sanitation were available for appointment as inspectors. This year, the work of the school will be enlarged, to include courses for health officers. So far as known, this is the only school in the world established for the purpose of training an official sanitary corps. The Institute, of which this school is an appendage, will also engage in research work. One of its members, Dr. P. G. Igaravidez, was sent last year to attend the School of Tropical Medicine in London.

Aeronautics

A New Altitude Record for Balloons is announced in a book by Dr. A. de Quervain, describing his recent crossing of Greenland. Two members of his party, Drs. Jost and Stolberg, remained on the west coast, and during the winter of 1912-13 sent up pilot-balloons 120 times from the Danish scientific station at Godhaven, Disco Island. One of these was followed with theodolites from the ground to an altitude of about 39,000 meters (24.2 miles), which exceeds by about 4,000 meters the greatest height ever before attained by any form of aerological apparatus.

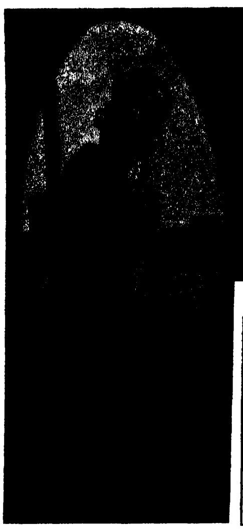
The German Air Traffic Bill.—The Reichstag recently took up a bill for regulating aircraft traffic. According to the *Engineer* the bill aims, in the first place, at minimizing accidents, and provides for this purpose that all new aeroplanes and airships are to be first tested on a flying ground. A second part of the measure deals with aerial navigation companies. As no such undertakings yet exist, great freedom is given to the Federal Council to issue regulations on this subject. Finally, the bill regulates by a number of complicated paragraphs, in which the provisions with regard to motor car traffic have for the most part been adopted, the liability for accidents caused by aircraft.

Russian Air Fleet.—The Russian government has drawn up a programme which provides that orders shall be placed for 330 aeroplanes, including 90 Sikorsky monoplanes and biplanes of the ordinary size and 10 giant Sikorsky machines of the type of the "Ilya Mouromets." For the small aeroplanes other than those of the Sikorsky pattern, recourse will be had to foreign types, such as the Farman, Deperdussin, Morane-Saulnier and Voisin. Two aeroplanes will be ordered from the German firm of Rumpler and two from the English firm of Sopwith, and two will be constructed on the system of the Russian Lieut. Kowanko. Besides these aeroplanes, two dirigible airships will be ordered in France and one in Russia. The programme will be completed by the autumn.

Atmospheric Pressure at Great Heights.—It is usually supposed that at great heights the pressure of the air is almost negligible, but the application of an ingenious method indicated by Ramsay gives interesting results. He asserts that the green line characteristic of the spectrum of krypton remains visible under a pressure of 0.000035 millimeters of mercury. Now this green line is found in the spectra of the aurora borealis and it seems to be well established that this exists frequently at altitudes between 100 and 200 miles, and even sometimes up to nearly 500 miles. But krypton is one of the heaviest gases in our atmosphere. It would seem, therefore, that the density of the air at these altitudes is by no means negligible, as whatever the cause may be of the presence of krypton there, it could not remain there unless the air possessed an appreciable density.

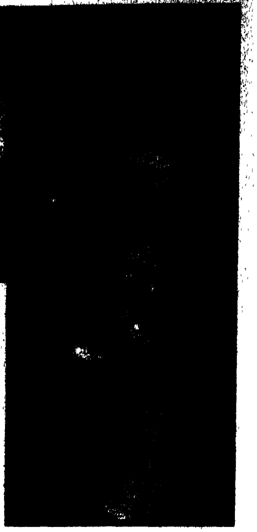
A New French Motor. The new Paris-built aeroplane motor known as "E. J. C." differs from the usual types because it uses a double propeller, that is two separate propellers rotating in opposite directions. The motor is of the kind in which the crank-case and six radial cylinders rotate in one direction, while the crank rotates in the other by mutual reaction alone. One double-blade propeller is keyed on the crank-shaft and another of the same kind, but with inverted thread, is mounted on the body of the motor, one screw being just back of the other, and the pair taking an X-shape when seen from the end. The screws are designed so that motor body and shaft take the proper speeds which are needed, there being 800 revolutions per minute for the motor and 1,200 revolutions per minute for the shaft, making a total of 2,000 revolutions per minute. But as the speed ratio varies with the running speeds, a differential is used inside the crank-case, so as to regulate the speed in the proper way. The present motor is of 60 horsepower size.

The Proposed Exploration of New Guinea by Airship, which has already been mentioned in these columns, does not seem likely to be realized in the near future. The original plan of Lieut. Graetz and his colleagues (some of the latter being scientific men of considerable eminence in Germany) was to raise the money needed for the expedition, about $750,000, in the three countries exercising sovereignty in New Guinea, viz., Germany, Holland and Great Britain. It has been found, however, that little interest was felt by the Dutch and British publics in this German project, while even in Germany the raising of funds has not made much progress. Moreover, the German Colonial Office has expressed disapproval of the undertaking, chiefly on the ground that the frequency of thunderstorms in New Guinea would make such an expedition extremely hazardous. Even if successful, it could add nothing to the world's knowledge of the biology, ethnology or geology of the island. The latest plan of the would-be aeronautical explorers is to exhibit their airship at the Panama-Pacific Exposition, and run a series of excursions with it for exposition visitors in order to raise money for their expedition.



A commander in working costume.

On the bridge of a modern dreadnought.



Enlisted man pointing a rapid-fire gun.

The Problem of Our Navy

X.—Making the Navy an Economic Asset

By Hon. Josephus Daniels, Secretary of the Navy

NO memory lives longer in the minds of a people than the remembrance of their past achievements in arms. It is well that this is so, for the inspiration of the past has enabled more than one tiny nation to defy its enemies and preserve its national existence against all comers Yet we need to beware that this undying recollection of ancient deeds of valor does not make us reckless. It is also true that more than one nation, remembering its dead heroes, has beaten its swords into plowshares and forgotten the cunning of war for the cunning of trade, only to find that the deeds of gallant ancestors will not prove effective in defense if we are not prepared. It is well, I think, for our nation to bear in mind, when the spirit of '76 and the memories of the minutemen of Lexington arise strong within us, that we may be, perhaps, over-prone to feel that in our hour of need there will spring up heroic men who, like our ancestors, will conquer because they know not how to fail. Man against man we will have nothing to fear, but to-day it is not only man against man, but machine against machine as well. The man will always be equal to the occasion. For every crisis a man will arise But while the man is greater than the ship, in our day the master man cannot win as aforetime unless we have the best ships and the best guns

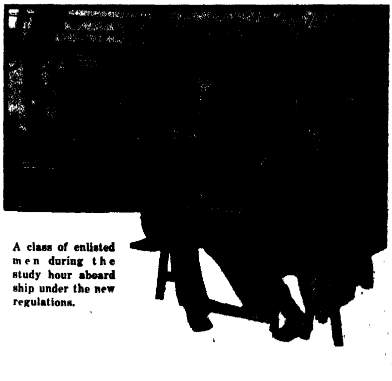
It is this feeling, in my judgment, more than any other, that leads so many of our people to shut their eyes to the cold facts and declare that a nation which in its infancy humbled the pride of England on the sea has no need of floating fortresses of steel to defend it in this, its high noon-tide of mature greatness That such is the view of no small portion of our people cannot be denied. Congress is peculiarly sensitive to what the voters think, and no Congress would have cut our warship construction to one battleship a year in the face of the ambitious naval programmes of other powers had not a majority of the congressmen felt, at the time, that the voters "back home" rested secure in their dream that, in some way or other, dreadnought or no dreadnought, this nation would find some miraculous way of defending our shores against a powerful foe. That a clearer vision came later, and that the people have made it evident to Congress that a majority do not so hold, does not destroy the fact that this misplaced confidence exists in no small degree, particularly in those States far removed from our coasts.

Glories of the Past and Present Necessities.

I speak with greater assurance of this because the same feeling instinctively pervades my own sub-consciousness. Over the mantel by my desk hangs the sword of John Paul Jones; at the other end of the room, the silver urn presented to the great Hull. As I look first on one and then the other, all the cold facts, so ably presented to me by the naval experts—men of the highest scientific knowledge, who have spent their lives in studying this subject—lose, for the moment, their convincing power, and the feeling comes over me that with such men as naval captains a probable defeat upon the sea is foolish to consider. It is only when I turn to look directly across my desk at the model of the "Oklahoma"—so little like the white-sailed ships of the line, so scientifically grim and strong and impregnable, the physical embodiment of the cold science of to-day that aims entirely to eliminate the personal equation—that I again realize that more than a glorious spirit is needed to win a modern fight at sea, although now and always initiative, resourcefulness and courage are a trinity of determining factors in the crisis of battle.

The stricken captain of the next naval engagement will not die leaning against the mainmast, with the shadow of the enemy's sails falling across the deck, rallying his men to repel boarders. He will perish helplessly, in spite of courage unsurpassed, in a conning tower built like a burglar-proof safe, from a shell fired by an almost invisible enemy seven miles away, out of a gun that was pointed by strict mathematical rules after the working out of an elaborate algebraical equation.

I am mentally convinced, as any reasoning man who has studied the subject must be, that our Navy should be strengthened. I subscribe to much of the argument in the series of articles in this paper, to which I contribute this closing number; but if, in spite of the advantages given me by my position to learn the whole truth, it is hard for me to shake off this instinctive feeling that our nation needs no protection beyond its own brave citizens, how much more must those living far inland, whose only knowledge of dreadnoughts comes from the illustrated papers, hold to the view that Providence will protect our country without the need of dreadnoughts, and that an adequate navy is merely a needless national expense.



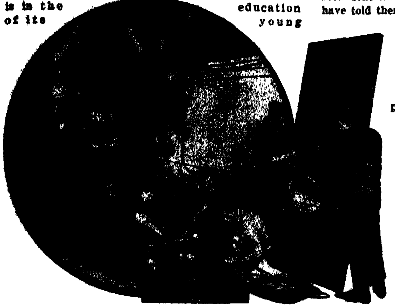
A class of enlisted men during the study hour aboard ship under the new regulations.

The Navy and the People of the Inland.

I sometimes fancy that our naval officers fail to understand the extent and depth of this feeling throughout the country. It is a point of view impossible to men like themselves who, from the day when they entered Annapolis, have had cold facts and figures hammered into them regarding the necessity of a defensive fleet to any country whose coasts are worth the harrowing and whose ports can be made to yield vast tribute to an attacking fleet. Because the popular point of view of this and kindred subjects is impossible for the trained naval man to understand fully, our wise forefathers decided that a civilian should be placed at the head of the Navy, a man who, understanding the feeling of the non-military people, can best adopt measures and frame arguments that will convince them of the imperative need of adequate powers of defense; for I hold that no one can convince until he understands what doubts are to be removed. In my own case, when I became convinced that loyalty, unswerving patriotism, and an exact scientific knowledge of the facts underlay the insistent demands of the Department's naval experts for an adequate Navy, the problem as laid before me took this form: Many people believe that an increase in the Navy is needless. This belief is instinctive and not founded on an investigation of the facts or knowledge of the subject. To convert a majority of these people, it would be useless to publish pages of statistics of numbers of ships, relative displacements, comparative muzzle energies, armor efficiency, steaming areas and kindred data, because the majority of them would not take time to read such tables, nor attempt to understand them if they did. Their gravest objection to an adequate navy is because of their belief that the Navy represents an expense to the Government without compensating benefit in return. The task that lies before the Secretary of the Navy, who understands this feeling on the one hand, but who has become convinced of its erroneousness on the other, is to find some way to secure at least the passive support of these people.

Can the Navy Be Made "Practical"?

Such being the problem, it would seem that if a way could be found to convince this portion of our people that the Navy is not merely an expense, but an economic asset to the country and a good business investment of the taxpayers' money, it would go a long way toward a solution of the [illegible] would [illegible] them from a position [illegible] is one of absolute encouragement of a larger naval construction programme. The greatest economic loss to the country from the Navy, be it necessary or unnecessary, lies not in the money spent, but in the 50,000 men taken from gainful industrial pursuits; for the money spent on the Navy, it must not be forgotten, goes back again into the taxpayers' pockets, to a very large extent. The Navy is not like the rich American who goes abroad to spend his money, but the funds appropriated are used to pay American workmen and American merchants and American manufacturers, and is, in time, distributed among other American citizens, so that, in the end, practically all of it gets back into the taxpayers' pockets from which it came; but if the country loses the productive services annually of 50,000 men, it is a real economic loss without compensation. Now, it is practically universally admitted by students of economics and political economy that the best investment a great and powerful nation like our own can make is in the education of its young men, particularly along industrial lines, and that the nation which has the most efficient and well-trained citizens, skilled to use their heads as well as their hands, is most certain to win in the fierce competition for the world's industrial supremacy. On this point, the theorists and legislative bodies of the great nations of the world are agreed, if the legislation in all these countries in the last few years means anything.



Electrical school, Navy Yard, New York.

Naval Appropriations for Education.

You do *not* hear of legislative bodies in our country, or in any other, squeezing to the last degree appropriations for education; and in Germany, which is one of the leaders in all scientific and industrial movements, provisions for the education of the workman along the lines of his profession are being constantly increased. In our own country, he would be a brave congressman who would dare to say that the hundreds of millions spent by the taxpayers on our public schools was a wasteful extravagance or a needless expenditure of money. If, therefore, it is necessary to make our Navy not only a proper protection to our country, but an economic asset as well, if we would gain universal support to its proper upbuilding, and if the real economic waste of our Navy at present is in the men withdrawn from industrial pursuits to man our ships, why cannot the result aimed at be achieved by taking these men during the time they are in the service of the Navy and training them to the highest degree, so that on their return to civil life they will become a hundredfold more efficient industrial units than they were before?

Yeomen's school, Mare Island, California.

If we can do this, it seems to me we will make the Navy in times of peace a national asset that will be well worth the money. I feel that the Navy presents a great opportunity and should play a great part in the training of our young men. Consider the situation! Here are 50,000 young men, in part suffering from the handicap of limited educational opportunities, and in part, of the type which makes the poorest industrial unit, the type that chafes at the strict discipline of home and factory, and that likes to wander abroad and see new things. If the Navy can take these men, advance their school-book education while, at the same time, training them in discipline, until they realise that to command they must first learn to obey, and in addition, can train their hands to be skilful in the industrial arts, it will surely be something really worth while.

What the Secretary of the Navy is Trying to Do, and Why.

I am not, here, discussing the necessity for increasing the Navy in any case, but of trying to turn what some consider a necessary evil into an important factor in the development of the nation and, in so doing, securing the support of those who remember only John Paul Jones and forget what happened to an inferior fleet, though manned by brave men, at Santiago. I have tried to elaborate in detail the reason underlying my efforts to make the Navy a great school, as well as a greater enforcer of the peace. As for the details of what has been done along these lines, the newspapers have told them in full; the daily classes for *the sailors, the technical* training and opportunities to learn a useful trade now offered all enlisted men—all this has been printed many times.

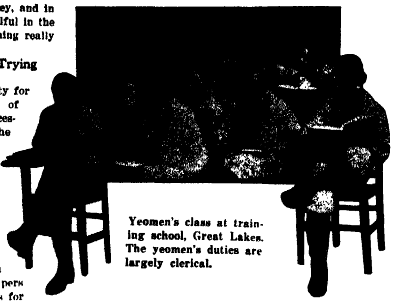
My purpose here is to make my reasons plain. There have been many merry quips by newspaper paragraphers, and sometimes a serious misunderstanding of the aims of this new policy, and I would like the public to understand just what the present Secretary of the Navy is trying to do and why. To the question: Has this plan, so far as it has been in operation, given evidences of success? The best answer lies in the enlistment figures. I have had prepared a chart showing the enlistments this year as compared with the year previous, which is reproduced for the first time with this article. It will be noted that from the 4th of March, 1913, until April of that year, the rapid decline in enlistments of the year previous continued. In April it was definitely published that the fleet would visit foreign shores, and I then announced that it was my purpose to add what has been described as the "liberal education of travel" to my other educational plans for the seamen of our Navy. In the next two months the enlistments increased far beyond the highest point of the year previous.

After the fleet had sailed, the enlistments naturally dropped off, though to nowhere near the low point of the year before. In November, the details of my educational ideas were made public, and were commented upon generally by the papers. From 1565 enlistments in November, there was a jump to 2,000 enlistments in December, breaking all records in times of peace. Could better answer than this be made to the question?

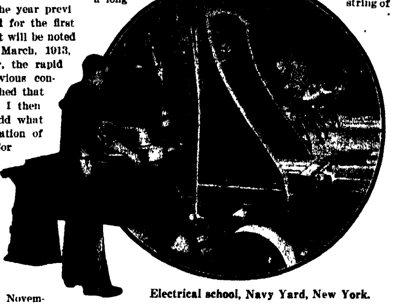
"An Adequate Navy Large Enough and Powerful Enough to Make War with the United States too Unpleasant in Its Consequences to be Seriously Considered."

There are still many details to be worked out, but, so far, no serious objections have arisen to the accomplishment of my dream—an adequate navy, large enough and powerful enough to make a war with the United States too unpleasant in its consequences to be seriously considered by any foreign power, and, at the same time, a navy that will receive young boys with untrained habits and little technical skill and transform them into young men trained to discipline, physically fit, and possessed of a practical knowledge of technical mechanics, that will enable them to bear more than their share of the work of making our nation the greatest in the world. If this policy is successful, if this dream comes true, *may* we *not* claim that our Navy is *no* longer a necessary, though regrettable expense, but is, in reality, in a large sense an economic asset to our country?

An Automatic System of Calling Cabs, known as the "Autoruf" system, is described by the American consul general at Hamburg, where the system has recently been installed. Machines bearing an external resemblance to letter-boxes have been placed in all parts of the city, and are connected by wire with a central office. These machines serve as cab-stands, though it frequently happens that there is no cab at the stand. In the latter case a customer who wants a cab deposits a coin (one mark) in the machine, and his call is automatically signaled to the central office, which sends him a cab from the nearest stand at which one is available; the money deposited is credited toward his fare. The presence or absence of cabs at every stand in the city is indicated on dials at the office by another automatic device, and each of the machines is provided with a calling-horn and a telephone, by means of which orders are transmitted from headquarters. Cabs summoned by telephone to a customer's home, office, etc., are also sent from the nearest stand by this system. The whole plan insures both economy and efficiency of operation, as it enables cabs to be moved about promptly wherever they are needed, and reduces the total number necessary for the business of the city. It no longer happens, as formerly, that some stands have a long string of idle vehicles, while others, where cabs are urgently wanted, are bare.



Yeomen's class at training school, Great Lakes. The yeomen's duties are largely clerical.



Electrical school, Navy Yard, New York.

The Biological Survey and the Forest Service have been co-operating in the extermination of ground squirrels on national forests in California. The annual loss of range feed and grain crops from ground squirrels is enormous.

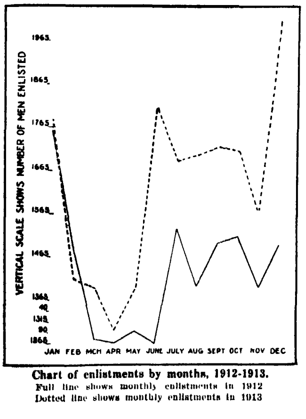


Chart of enlistments by months, 1912-1913.
Full line shows monthly enlistments in 1912
Dotted line shows monthly enlistments in 1913

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Red Coloring Matter of Radishes

To the Editor of the SCIENTIFIC AMERICAN:

I have been investigating the red coloring matter that is found in the skins of radishes and apples and in geranium blossoms. What is its name, and chemical formula?

It is an indicator, orange red in acid solution, and lemon yellow in alkaline. In changing from the red to the yellow it goes through reasonably well defined crimson, purple, and green stages. How do you account for this color change?

It seems to be very sensitive, abundantly found in nature, and easily extracted. Why is it not generally used as an indicator?

I have been unable to find anything about this very interesting coloring matter in any of the botanical and chemical reference books to which I have access, and I hope you can give me a little light on the subject. If no extensive research has been made along this line, I intend to investigate further. A. M. P.

Waxahachie, Texas.

Tapping a Telegraph Cable

To the Editor of the SCIENTIFIC AMERICAN:

The writer is in charge of an engine-room which happens to be built close to where a telegraph cable leaves the shore for England.

Before they enter the cable the telegraph wires are carried overhead from the island post office and pass within five feet of this building.

In the course of experiments the writer found that it is possible, by merely connecting a telephone receiver to any part of the engine and connecting the other terminal to ground, to read the Morse code messages passing on the wires outside.

An iron air pipe connected with the engine and passing overhead, within the building, for about 20 feet and then dropping downward into the earth seems to be the means by which these inductive messages are received.

Having proved the possibility of picking up messages in this way the writer has no further desire to continue the experiment, which is of interest as showing what it is possible to do, sitting inside a building, with no outside connections whatever.

On one occasion a message from the local post office was read, passing to London, announcing the sailing of a certain vessel.

Confirmation of the correct reading of the message arrived a few minutes later, when the ship referred to was seen sailing outward. EDWIN O. CATFORD.

Platte Fougère Lighthouse, Guernsey, England.

The Tide Predicting Machine

To the Editor of the SCIENTIFIC AMERICAN:

In view of the general tone of an article appearing in your issue of March 7th, entitled "A Great Brass Brain," and other articles of like import which have appeared from time to time, I deem it my duty to take this occasion to state publicly that the fundamental conceptions which distinguish this machine from all other tide-predicting machines did not originate with Mr. Fischer, but with myself. So far as comparisons are legitimate, it may be said that my part in the creation of the "new" or "simultaneous" tide-predicting machine is quite analogous to Ferrel's part in reference to the machine which is associated with his name. Mr. Fischer's part was that of a detailed designer rather than that of the original inventor.

One of the items of evidence which may, with propriety, be noted here is the following:

In the Coast Survey Report for 1894 (Part II), pp. 181, 182, I gave a brief description of a machine designed to carry on simultaneously all operations required in tidal prediction. This may be regarded as the first description of the new machine. It was written before the Survey took up the consideration of the construction of a machine. R. A. HARRIS.

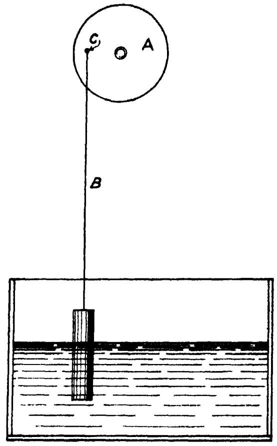
Washington, D. C.

Suggestion for Tide Predicting Machines

To the Editor of the SCIENTIFIC AMERICAN:

I was much interested in Mr. C. H. Claudy's description of the United States tide predicting machine, No. 2, under the heading of "A Great Brass Brain," which appeared in your issue of March 7th. A simple method has occurred to me whereby the construction of such a machine could be greatly simplified, and the chain eliminated, which Mr. Fischer strove to do without success.

Imagine a revolving disk *A* provided with an adjustable eccentric crank *C*, from which hangs a metal cylinder by means of the thread *B*. This cylinder dips into a basin of water or oil or mercury. As the disk revolves the cylinder moves up and down, and the level of the water rises and falls accordingly. This represents one component of the tide, but we may have any number of these units working independently at the same time to represent the other components. The sum of their varying motions will be exactly represented by the varying level of the water in the basin. In other words, the real tide will be reproduced in miniature in the basin. A graphic record of the tide could be made by means of a float with a stylus attached.



Producing a tide in miniature.

Detroit, Mich. N. P. LEVIN.

Solar Halos

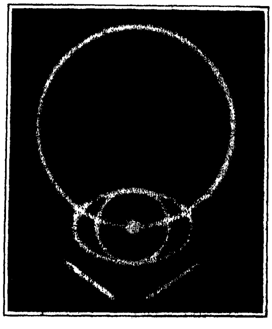
To the Editor of the SCIENTIFIC AMERICAN:

The letter in your paper of February 7th, 1914, from E. C. L. Miller, giving an account of some halos about the sun, recalled to my mind a set of somewhat similar ones that I saw from Nonquitt, Mass., at about 10 A. M. on September 14th, 1900. They struck me as so remarkable that I made a rough drawing of them in my diary at the time, a copy of which I send you.

All the lines were more or less rainbow colored and were especially bright where the lines touched each other. EDWARD M. STETSON.

New Bedford, Mass.

[The study of solar and lunar halos, one of the most interesting byways of science, appears to be enjoying renewed popularity in this country owing to the impression created by the remarkable and widely observed halos of November 1st and 2nd, 1913. This is especially gratifying for the reason that, owing to the comparative rarity and the evanescent character of such phenomena, the perfection of the still fragmentary theory of halos depends upon the collaboration of a large number of painstaking observers. The more persons there are who maintain a vigilant lookout for halos, and prepare accurate drawings and descriptions of those which they see, the greater amount of material will there be for the use of the specialist in dealing with the, at present, obscure questions relating to this branch of optics.



Halos seen on the morning of September 14th, 1900.

S, the sun; *AB*, a large circle parallel to the horizon; *EF*, a circle around the sun; *CD*, an ellipse tangent to *EF* at the top and bottom points; *G* and *H*, two straight rainbow colored lines.

For the encouragement of persons who have a mind to take up halo-observing as a hobby it may be remarked that most varieties of halo are far commoner than they are generally supposed to be, even by meteorologists and physicists. This fact is strikingly illustrated by the records of the Montsouris Observatory, in Paris, where halos are probably observed more assiduously than anywhere else in the world. Thus the commonest of halos—the circle of 22 degrees radius around the sun or moon—was seen at Montsouris on 1,317 days in ten years; an average of one observation every three days. The ordinary parhelia, or sun-dogs, were seen one day in twelve; and the beautiful circumzenithal arc, with its brilliant rainbow colors, one day in 33.

In Mr. Stetson's drawing, herewith, *AB* is the parhelic circle; *EF* is the common 22-degree halo; and *CD* is the circumscribed halo. The lines *G* and *H*, which he has drawn straight, but which really have a slight curvature, with convexity toward the sun, are the extremely rare infralateral tangent arcs of the 46-degree halo; these were observed only twice at Montsouris in ten years.

A comprehensive description, with diagrams, of the known forms of halo was published in SCIENTIFIC AMERICAN SUPPLEMENT, No. 1924, and will be sent to any address for 10 cents.—EDITOR.]

The Canadian Society of Forest Engineers

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of March 28th, you have a little news note in regard to the election of Dr. B. E. Fernow to the presidency of the American Society of American Foresters. In this you say, "This is the only organization of professional foresters in the Western Hemisphere." Will you kindly correct this, as we have also a Canadian Society of Forest Engineers, which was formed in 1906, which has fifty active members and some fifteen associate members, Dr. B. E. Fernow being president; R. H. Campbell, Dominion Forester, vice-president; and myself as secretary.

Grand Mère, P. Q. Canada. ELLWOOD WILSON,
Superintendent of Forestry Division.

Motor Car Speeds and Falling Bodies

To the Editor of the SCIENTIFIC AMERICAN:

The SCIENTIFIC AMERICAN has been the source of much valuable information relating to danger incident to different modes of travel, and since so large a majority of the people now ride (and speed) in automobiles, a hint to them of danger that but few people realize, may interest its readers.

The following computation is designed to compare the speed of an automobile (or other vehicle), as seen by the speedometer registering "miles per hour," with the velocity of a falling body, passing through space at exactly the same rate of speed. From the following table it may be seen that a rate of 40 miles per hour (for example) is exactly the same velocity that a falling body attains from a height of 53.78 feet, under the law of gravity. In other words, a direct impact in a wreck at a speed of 40 miles per hour, is the same as one would sustain by falling 53.78 feet. A striking impression may be afforded any person, by standing on the top of a battlement 53.78 feet high, and contemplating jumping off; and yet, his impact at 40 miles per hour would be the same.

It may be observed from the formula from which this table is computed ($d = 0.03361m^2$) that the danger increases as the square of the number of miles per hour:

d = the height of the fall,

m = the miles per hour one is driving.

Sixty miles per hour (a common boast of "Joy Riders") would be equivalent to a fall of 121 feet.

10	miles	an hour	equals	a fall of	3.36	feet
15	"	"	"	"	7.56	"
20	"	"	"	"	13.44	"
25	"	"	"	"	21.01	"
30	"	"	"	"	30.25	"
35	"	"	"	"	41.17	"
40	"	"	"	"	53.78	"
45	"	"	"	"	68.05	"
50	"	"	"	"	86.53	"
55	"	"	"	"	101.67	"
60	"	"	"	"	121.00	"
70	"	"	"	"	164.69	"
80	"	"	"	"	215.10	"
90	"	"	"	"	272.24	"
100	"	"	"	"	336.10	"

The danger increases rapidly, especially above 30 miles per hour. S. F. KENNEDY.

The Guns of Panama.

The Powerful Defenses at the Terminals of the Canal

By Charles M. Maigne, U. S. A.

THE integrity of the Panama Canal is, of course, of more importance to the United States than to any other country.

Built by money and brains, furnished by our people, the comity of nations demands that its use and benefits be extended to the world at large in the interests of development and commerce; so upon its completion, in time of peace, the great gates will swing open in welcome to any vessel which sails the seas and pays the toll which must be exacted for the maintenance of the waterway. The laws and customs of the civilised world and the precepts of international law are primarily for the preservation of peace, at home and abroad. Peace is the rule and war is the exception, and that the world at large may reap the benefits of the canal the relation of other countries with the United States must be amicable. To the merchant marine and the squadrons of friendly powers, then, the canal stands for peace.

But there is a deeper significance to this country underlying the toil and trouble, the money and men which have gone into the making of this gigantic engineering triumph.

The shifting courses of war may never be forecasted, and it is easily conceivable that from a tiny spark of difference between us and some other first-class power, a cyclone of events and popular opinion might readily fan a blaze of war which would bring to our coastline a foreign fleet, less powerful than our Atlantic and Pacific fleet combined, but superior to either alone.

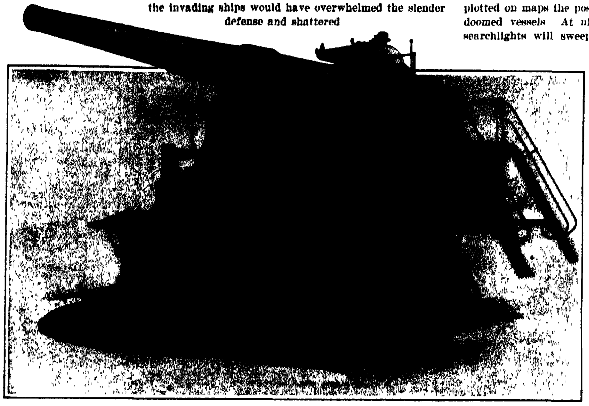
The successes of the greatest military genius who ever lived, Napoleon Bonaparte, were founded upon dividing an enemy superior in numbers and overwhelming the severed wings in detail. Strategy, whether of the land or sea, has not changed in its fundamental principles with the perfection of modern armament; and to prevent the junction of our Atlantic and Pacific fleets, a foreign squadron, to win its way, must strike promptly and strike hard at the Panama Canal

Panama Canal is Greatest Naval Strategic Point in Whole World.

History shows us that the outcome of wars has laid low the might and majesty of many a powerful nation, has even swept the very individuality of a mighty people into an absorption by the conquerors, and left but a tarnished name on its pages to tell of past glories. What has been may be once again. For where would our engineering feats, commerce, wealth, unity, our country, stand if an enemy's mail-shod foot pressed us, defenseless and defeated, in to the ground? We should be broken, disintegrated, prostrate at his mercy, our wealth in his coffers, and his flag above our heads. The Panama Canal, the connecting link between our severed squadrons, stands, therefore, in its greatest meaning, to the people of the United States, not for peace, but for war, and to preserve its usefulness to us, against the greatest time of need, it must bristle with guns sufficient to defend it against any possible foe!

To insure that it remains ours we have already shipped to the ports of the Isthmus some hundreds of thousands of tons of steel, wrought into the forms of the mightiest engines of war ever known to man, and with these guns have gone disappearing carriages and ammunition, electrical appliances, and searchlights, shiploads of steel girders and a countless array of cement barrels containing the gray dust from which the concealed gun emplacements will be built.

Suppose the canal were not amply defended. Before the impending crisis of naval battle between the fleets, the invading ships would have overwhelmed the slender defense and shattered it until they could glide into the locks and take their choice of pushing through in an attempt to crush our weaker fleet on the far side, or lay a charge of high explosive within a lock wall or the Gatun dam or wreck the gates, and then decisively defeat our small fleet on this side before our opposite fleet could round the Horn and effect a junction.



Panama Canal Defenses—14-inch breech-loading rifle.

Length, 48 feet, weight, 09 tons; weight of projectile, 1,660 pounds; range, 18,000 yards; penetration, 13 inches

Suppose the canal were sufficiently defended While the foreign fleet was pounding away in a vain attempt to silence our land guns, summoned by wireless, both of our fleets would be hurrying down their coasts to the canal; and, with the army's triumphant guns holding off the enemy, the far fleet would slip through the canal, the junction would be effected, and the enemy crushed by our combined fleets. Let us see how these defending guns will be placed. The plan of the fortifications will not be given out; but ordinary reason tells us that the guns will be about evenly divided between the eastern and western entrances to the canal. The hills near the sea will shadow dun, turf-covered emplacements. Islands, small and large, will each nurse in its breast the sunken mortar pits, also concealed: and it is even whispered that caissons will sink to the bed of sandbars and support artificial islands of concrete and steel in which will be emplaced invisible batteries.

At war's approach, the fairways will be strewn with mines, to be exploded, either on contact with an enemy's hull, or by the pressure of a tiny key in a secluded house, from which telescopes have marked the approach of the hostile ships and where dexterous fingers have plotted on maps the positions in the mine square of the doomed vessels At night, the quiet fingers of great searchlights will sweep over the mine fields, and an attempted raid by small boats will be checked and crushed by the rapid-fire batteries which guard the planted mines

The guns which will constitute the main strength of the defenses will be of various sizes Chief among them will rise the giant 16-inch gun, the most powerful in all the world Then will come the 14-inch rifles, surpassingly deadly, the 12-inch mortars, against whose plunging shells no ship's deck armor may avail, and the 6-inch rapid-fire guns, to cover the mine fields

In the history of warfare there have been guns of larger bore than that of these at Panama. During the civil war, smooth-bores hurled spherical shells of 20 inches diameter, and there is the well authenticated story of a Turkish gun with a bore of 24 inches; but neither of these guns would have the slightest effect against modern armor, and their range was about equal to that of our 30 caliber rifle, now in the hands of each infantryman

The range of the 16-inch gun is about twenty-one miles at an elevation of 45 degrees, and the shell that twists its swift way high above the plane of sight weighs 2,400 pounds. There is no armor in the world can withstand the terrific impact of this mighty missile, propelled by a charge weighing 650 pounds.

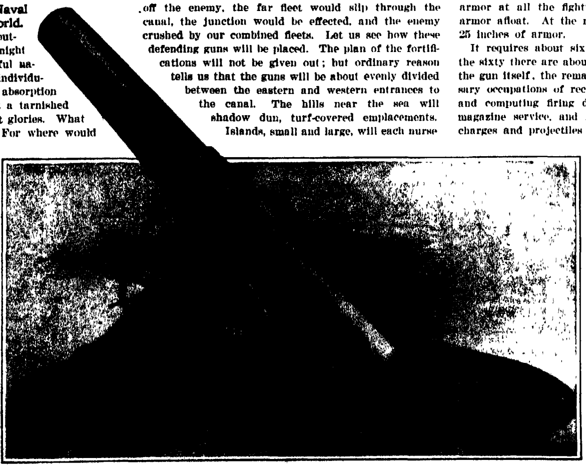
The conical shell itself lacks but two inches of being 6 feet long, is taller than the average man, and it has an average penetration of 17 inches of the hardest armor at all the fighting ranges There is no such armor afloat. At the muzzle, the shell will penetrate 25 inches of armor.

It requires about sixty men to serve this gun. Of the sixty there are about twenty-five actually operating the gun itself, the remainder are engaged in the necessary occupations of receiving the range and elevation and computing firing data, in telephone service and magazine service, and in supplying the gun with its charges and projectiles The service rate of fire, sustained in battle, is about one shot a minute, delivered with marvelous accuracy. It is entirely possible to greatly increase the rate of fire, but any such increase will always be at the expense of accuracy, and a discharge of the gun costs far too much to waste ammunition for the sake of a mere record.

One shell from this gun, with the charge, costing about $1,027.50, should it find its billet, as it probably will, would probably disable a battleship costing in the neighborhood of ten millions of dollars The gun-makers have rather the better of the competition with the armor manufacturers Ships are now carrying about their limit in steel armor

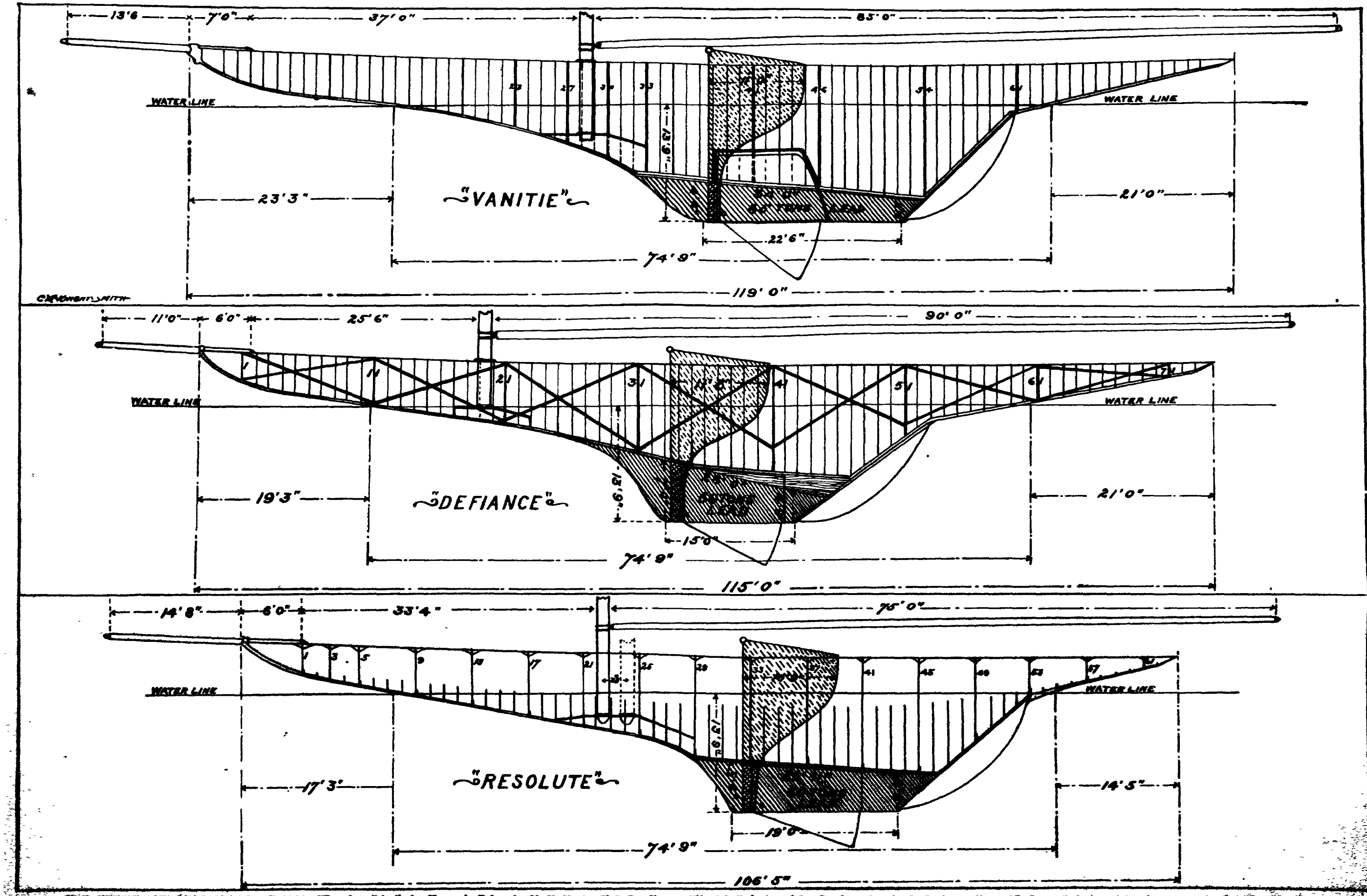
The 14-inch guns, which like the 16-inch will be

(Concluded on page 385.)



Panama Canal Defenses—12-inch mortar.

Length, 16 feet 8 inches; weight, 17 tons; weight of projectile, 1,070 and 700 pounds; range, 19,000 yards; pentration, any deck armor.

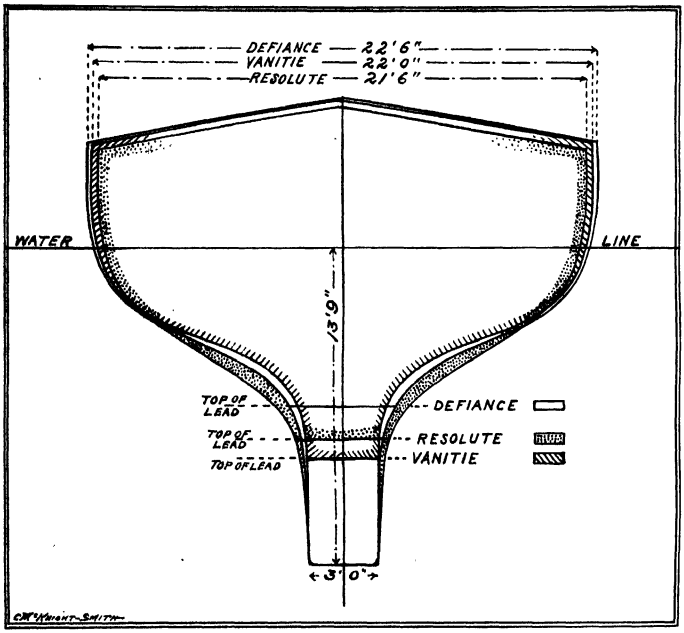


THE THREE CUP-DEFENDERS OF 1914—"Resolute," built by Herreshoff for the N. Y. Yacht Club Syndicate; "Vanitie," designed by Gardner for A. S. Cochran, Esq.; "Defiance," designed by Owen for the Tri-City Syndicate.

The Defense of the "America's" Cup

Construction, Sail Plans and Leading Characteristics of the Three Cup Defenders of 1914

NOW that the British challenging yacht and the three cup defenders are plated up and practically ready for launching, all of them having long passed the stage when any knowledge by the designers of the plans of their competitors, would come too late to have any effect upon the final issue, the SCIENTIFIC AMERICAN takes much pleasure in presenting to its readers the first authentic information regarding the three cup-defending yachts. That so much authentic technical information should be available for publication upon a subject in which the American public is so vitally interested, is an encouraging sign of the times. The old policy of maintaining profound secrecy, long after it has ceased to be necessary, has happily passed away, and the public is to be congratulated on the more liberal and sportsmanlike policy which recognizes the wide-spread national interest in the struggle for the "America's" cup.



Midship sections of the cup-defenders.

New Rule of Measurement.

The three yachts have been designed under the new rule of measurement which will govern this year's series of races. This rule was drawn up with the object of correcting the defects of the old rule. Under the old rule there was a tax on waterline length and sail area and on nothing else. Provided the yacht did not exceed 90 feet on the waterline, the designer might make her as broad, as deep, and as long on deck as he pleased; and he was at liberty to give her as large a sail plan as he wished. In determining the rating of the yacht, that is, the allowance she must give to or receive from a competitor, the waterline length and the sail area, only, were taken into consideration. The greater her waterline length, the larger her sail area, the greater would be the allowance which she had to make over a 30-mile course to her competitors. These were the only restrictions. Working under this rule, it was found that a yacht with a broad, shallow and generally scow-shaped hull, with long overhangs, carrying a great mass of lead at the bottom of a deep keel, and driven by a vast spread of sail, produced the fastest yacht under the average weather conditions off Sandy Hook. The most extreme yacht built under the rule was the "Reliance," which, on a waterline length of just under ninety feet, was over one hundred and forty feet in length on deck, and spread the enormous sail area of over sixteen thousand square feet of canvas. The bilges were hard and carried well out into the ends, the turn at the garboards from the floor into the keel was sharp; and it was the boast of Nat Herreshoff, her designer, that the "Reliance" had the largest sail area in proportion to the wetted surface of the hull of any yacht that had ever been built.

The racing yachts built under this rule lost their usefulness as soon as the cup contests were over. Their spars were too big, and their hulls too shallow, and their draft too great, to render them useful as cruisers; and most of those which were built for the last four series of races had to be broken up and sold for junk.

The changes introduced under the new rule were in the direction of producing a more wholesome boat, with a larger displacement, a smaller draft, a sweeter form with sharp ends—a form which would have a much easier motion in a seaway than the old scow form, which pounded heavily and was extremely wet in going to windward in a short sea.

A comparison of the cross sections of the three challengers of the present season shows the modifying effect of the new rule. The bilges are easy, the deadrise of the floor is steeper and the turn into the keel at the garboards is much fuller than in the yachts built under the old rule. The new rule *favors displacement*; that is to say, the yacht with the larger displacement, other things being equal, will have the smaller rating and the larger time allowance. Considered from every point of view, the cup yachts of the season 1914 are much abler and more satisfactory sea boats than their predecessors of the last four or five contests for the cup. Although the construction is very light, the materials have been so well disposed that the yachts are amply strong for the work they will have to do. Moreover, they will be available, when the races are over, for the regular yacht club regattas which are annually held on our coasts. If their future owners wish to turn them into cruisers, there is sufficient head room to enable the interior of their hulls to be bulkheaded and furnished with the necessary cruising accommodations. A reduction in sail plan can be made without any serious reduction of the speed, and the boats can be handled, under this reduced rig, with crews of moderate size

Points of Similarity and Difference.

In respect of two of the principal dimensions the three yachts are alike. Each is 74 feet 9 inches in length on the load waterline, and the draft of each is 13 feet 9 inches. Also, there is not much difference in the beam, only one foot, in fact, between the narrowest, "Resolute," and the widest, "Defiance," whose width is, respectively, 21 feet 6 inches and 22 feet 6 inches. "Vanitie" comes between with a beam of 22 feet.

Of all the drawings, the most interesting and instructive is that showing the midship cross sections superimposed. From this it will be seen that "Resolute" has the fullest and deepest underwater body, with an easy bilge, steep floor, and a full turn from the floor at the garboards into the keel "Vanitie" shows the least departure from the yachts built under the old rule, and, of the three boats, her bilge is harder, her floor flatter, and she is more cut away at the garboards, where the turn from floor to keel is rather sharp "Defiance" shows a cross-section midway between the two. The effect of these midship sections is shown in the other dimensions of the hulls Thus "Resolute" has much shorter overhangs than the other two boats, both forward and aft, her over all length on deck being only 100 feet 5 inches, as against 115 feet in "Defiance" and 119 feet in "Vanitie" Speaking broadly, it may be said that while the differences in midship section are not very great, "Vanitie" suggests something of the U-section and "Resolute" the V-section, with the "Defiance" midway between the two There is probably not much difference in the displacement of the three yachts, which is something over one hundred tons The Gardner boat, "Vanitie," with her harder bilges shows a more *powerful form* than Nat Herreshoff's "Resolute," and in reaching and running, or at any time with sheets started, she should be the faster boat. In windward work, and particularly in a confused sea, we should incline to favor the chances of "Resolute"

The most interesting feature of difference in the three yachts is the sail plan, and it will come as a matter of surprise that the Herreshoff boat carries a spread of sail which is surprisingly less in area *than that of the* other two yachts, the "Resolute" spreading 8,188 square feet, "Vanitie" 9,465 square feet, and "Defiance" 9,819 square feet, or 1,631 square feet more than the Herreshoff boat The modern tendency to make the rig lofty and relatively narrow is shown in the sail plan of each yacht, and this is particularly noticeable in "Defiance" "Resolute" on a base line of 131 feet has a vertical height from main boom to topmast truck of 125 feet; "Vanitie" on a base of 144 feet 6 inches shows a vertical height of 131 feet, whereas "Defiance" on a base line of 134 feet 6 inches has the enormous height of 146 feet. Both "Resolute" and "Vanitie" carry double headsails, and the division of the base line for the forward and after triangle is about normal practice. In "Defiance," however, *the mast has been stepped far* forward, and the bulk of the sail area is concentrated in the mainsail. Her boom has the enormous length for a 75-footer of 90 feet, as against 85 feet in "Vanitie" and 75 feet in "Resolute" From the forward side of the mast to the end of the bowsprit of "Defiance" is 42 feet 6 inches, as against 54 feet in "Resolute," and 57 feet 6 inches in "Vanitie" It is needless to say that "Defiance" carries only a single headsail

The concentration of so much of the sail area in one large mainsail has been favored by George Owen, the designer of "Defiance," in the expectation of securing fine weatherly qualities in going to windward Theoretically, "Defiance" should point high and foot fast while doing so; but, as everyone who has handled the wheel or tiller of yachts rigged in this fashion knows, she is liable to be a very difficult boat to steer. The

DIMENSIONS, ETC., OF THE THREE CUP DEFENDERS

	Resolute		Vanitie		Defiance.	
	Ft	In	Ft.	In.	Ft	In
Length over all	106	5	119	0	115	0
Load waterline	74	9	74	9	74	9
Draft	13	9	13	9	13	9
Beam	21	6	22	0	22	6
Forward over-hang	17	3	23	3	19	3
After over-hang	14	5	21	0	21	0
Mast, deck to cap	94	0	95	0	105	0
Topmast, cap to truck	35	0	40	0	45	0
Boom	75	0	85	0	90	0
Gaff	50	0	52	0	56	0
Bowsprit, outboard	14	8	13	6	11	0
Sail area	8,188 sq ft.		9,465 sq ft		9,820 sq ft.	

possession by "Defiance" of this rig will lend a special interest to the long series of contests which will take place during the present season between these three boats, to determine which of them shall be selected to meet Sir Thomas Lipton's "Shamrock IV."

Construction of the Yachts.

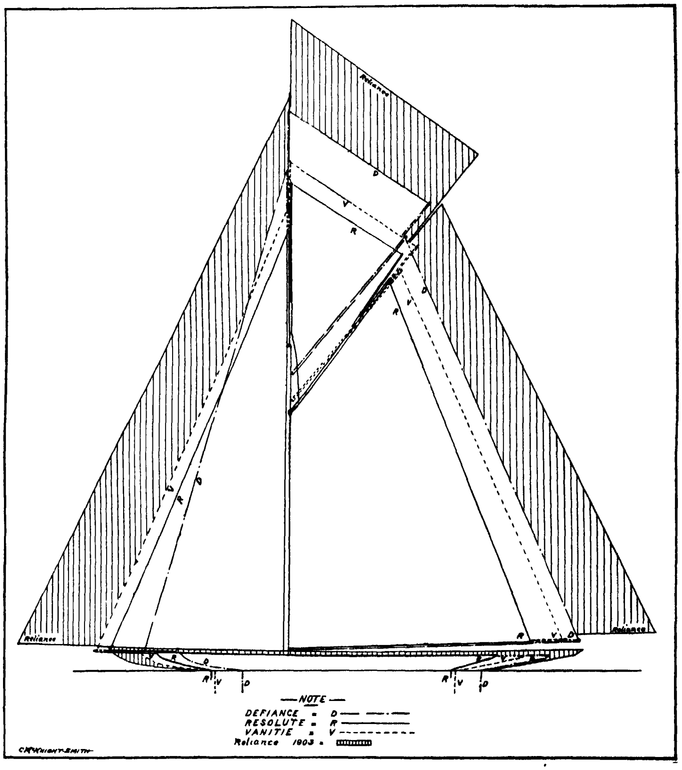
"RESOLUTE"—The construction of "Resolute" follows in general that type which Herreshoff originated in "Constitution" and "Reliance." It consists of a series of deep web-frames varying in depth from 8 to 12 inches, with lighter frames between, and longitudinal framing following the line of the seams of the bronze plating The plating is laid on with flush seams and butt joints It consists of 5/32 inch manganese bronze, and the lowest or garboard strake overlaps the lead 2 feet, the lead being covered with brass sheeting 1/32 inch thick. Intermediate with the deep web frames, which extend entirely around the hull, are shorter and lighter frames, three between each web There are two mast steps, spaced 33 inches apart, center to center The mast is built of nickel steel, stiffened with 2¼ by 1⅛ inch bulb nickel stiffeners. It is 20 inches in diameter at the foot. The topmast, 12 inches in diameter, is of wood, and it foots upon a steel cone within the steel mast and 5 feet below the cap The lead keel is placed between web frames 29 and 45 It measures 26 feet 11 inches on top and is 4 feet 6 inches deep at the heel and 5 feet 6 inches deep at the nose. The length of the lead on the bottom is about nineteen feet. The "Resolute" is decked with aluminium plates 7/32 of an inch thick, the whole deck being covered with canvas, sanded

"VANITIE"—The framing of "Vanitie" consists of web frames 10 inches deep, eight in all, which are spaced as shown in the drawing. The framing extends from the keel plate up to the covering boards, and consists in addition to the web frames of 8-inch by 1¾-inch L-angles. The "Vanitie" is plated with manganese bronze, which varies from 3/16 of an inch to 7/32 of an inch in thickness.

The mast is a hollow steel spar 20 inches in diameter, and the mast step is located between the web frames on stations 27 and 30. The lead keel measures 34 feet on top, and it is 2 feet 10 inches deep at the heel, and 4 feet 6 inches deep at the nose. It is secured to the hull on web frames 38, 41, 46, and 54

"DEFIANCE"—The hull of the "Defiance" is constructed of steel framing, overlaid by two thicknesses of wooden sheathing. There are 73 frame stations, and every tenth station is a deep web frame. This framing is tied together with diagonal straps, 3/16 inch thick by 6 inches wide, riveted to the outside of the frame. The inner sheathing of the hull consists of ¾ inch fir, and this is bolted to the frames with bronze bolts. Upon this is placed the outer skin of mahogany, 1¼ inch thick, which is fastened to the inner skin with bronze screws from the inside The deck plating is of pine. The lead bulb is 4 feet 9 inches deep at the heel and 7 feet deep at the nose, and it measures about 28 feet along the top.

The "Resolute," designed by Herreshoff, has been built by him at Bristol; the "Vanitie," designed by William Gardner, was built by George Lawley & Son, at Neponsett; and the "Defiance," designed by George Owen, was built by the Bath Iron Works, at Bath, Maine.



A comparison of sail plans.

French Artificial Wood.—Information has been made public in Lyons, France, concerning an artificial wood, which, it is stated, will be of great value as a substitute for natural wood. The new product has been found after years of study and practical experiments, the most recent of which have given eminently satisfactory results. The process consists in transforming straw into a solid material having the resistance of oak. The straw after being cut into small pieces is reduced to a paste by boiling, to which certan chemicals are added. When the paste has been reduced to a homogeneous mass it is put into presses, and planks, beams, laths, and moldings of all sizes are readily made. This new material can be sawed like natural wood. As a fuel, it emits a bright flame and little smoke. It is further stated to be adaptable to the manufacture of match stems.

How Bubonic Plague Reached Porto Rico

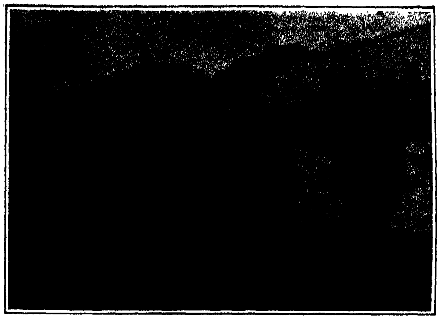
IT will be recalled that an epidemic of bubonic plague occurred in Porto Rico in the summer of 1912, throwing the whole island into a panic and paralyzing business, but fortunately resulting in only a small loss of life, owing to the very prompt and energetic measures taken by the health authorities. The source of this epidemic is revealed in the last report of the Government of Porto Rico, and the revelation constitutes a serious charge against an official health service in another quarter of the world. At first it was suspected that plague had entered the island through the medium of certain shipments of maize from Venezuela, the sacks containing infected rats. Another conjecture was that it had come from the United States on a ship in which two infected rats were found. Ultimately, unmistakable proof was adduced that the infection had been received from the Canary Islands. An epidemic of plague had occurred in the latter islands some time before the first case appeared in Porto Rico, but the Spanish authorities had concealed the fact from the world. Moreover, the health officials in the Canaries have naively admitted that plague had existed there for years, but they thought it best not to divulge the fact! Meanwhile vessels from the Canaries had been allowed to dock freely, without quarantine, at San Juan and at other ports throughout the world.

The Current Supplement

THIS week brings the two thousandth issue of our SUPPLEMENT. Among the principal articles appearing therein is the account of Dr. Bridgman's experiments on water at pressures of 20,000 atmospheres, or 300,000 pounds per square inch. These experiments have brought to light the interesting fact that in addition to the two kinds of ice previously known to science, there are three more, five in all.—Dr. V. Cornish contributes a most interesting article on the dimensions and velocity of ocean waves.—The second instalment of the account of the London Aero Show appears in this issue, accompanied with thirty-two descriptive illustrations.—What is the smallest object visible to us on the moon? This question is answered by Abbé Moreux for our readers.—A thousand-ton forming press for large metal objects is illustrated and described.—C. H. Bromley explains how a carbon dioxide absorber for the automatic registration of flue gas analysis works.—The nature and prevention of dust explosions in coal mines and factories is discussed in detail.—The temperatures in the various parts of a steam plant are traced from furnace to condenser.—Dr. J. H. Barach suggests a dynamic index which measures heart action.—What generator and accumulator equipment is recommended for different circumstances for country house electric power plants? The reader will find this question answered in a special article.—Diagnosing diseases in patients 1,500 years old—such is the task which Dr. Ruffer has set himself. A note on his work will be found on the last page of this issue.

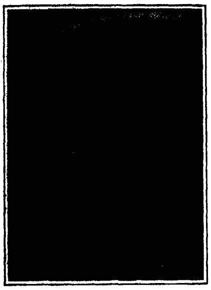
Primitive Mining in Mexico

WEIGHING a miner and his load together is the method used by a Mexican company to ascertain the quantity of ore brought to the surface. Of course the weight of each man and his outfit is noted in the weigher's memorandum book, so the amount of ore is figured at a glance. The methods of bringing the ore to the surface are primitive, indeed, compared to the electric hoists used in mines of modern equipment. The group of peons with their rough baskets filled with ore is eloquent of the cheapness of human labor in the mines of our neighboring lands to the south. In some old workings the loads are still raised by the Mexicans, who climb to the shaft's mouth by ladders, bearing heavy baskets or sacks on their shoulders.


To guard against theft, miners in Mexico are weighed with their load of ore.

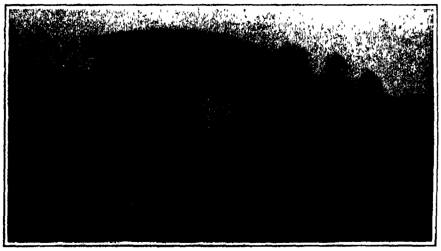
Teaching Swimming With Trolleys

A NEW system of teaching boys and girls how to swim has been instituted in certain Cincinnati schools equipped with bathing pools. An apparatus is employed consisting of an oval track secured to the ceiling over the pool. A dozen trolleys run on the track, and from each depends a rope with a belt attached. Twelve pupils fasten the belts around their waists and the swimming lesson is on. They go through the motions of "sailor fashion" and the "Australian crawl" as per the direction of the swimming instructor, who keeps watch from around the edge of the pool. They cannot sink, so the only thing remaining for them to do is to swim. This "water-merry-go-round" has proven so successful that others like it are to be installed in schools where a bathing pool is a part of the equipment.


A trolley swimming lesson.

Motor Car Locomotive

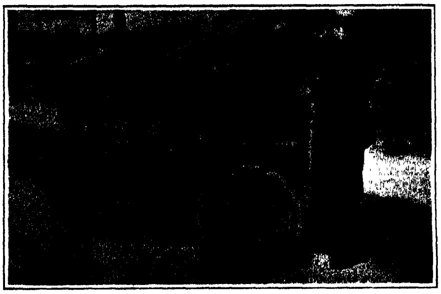
RECENTLY we illustrated in these columns a touring car used for passenger transportation on a small western railroad. Pictured herewith is another car used for a similar purpose, and also acting as a locomotive for a freight train. It furnishes daily service from Westmoreland to Blaine, Kansas. The rear wheels of the automobile are fitted with flanges to fit the track rails, and the front wheels have been replaced by a four-wheeled swiveled truck. This motor-car locomotive is able to haul three small freight cars. The picture shows the train loaded with six tons of freight.


Combination freight and passenger train hauled by motor car.

Up-to-Date Scissors Grinder

IT has often been said that the advent of mechanical operation has killed the small industries, but recent developments in engine design, especially the construction of gasoline engines, are bringing about an opposite tendency, and the individual artisan frequently finds a powerful help in the adoption of such motors for driving his tools, or operating a dynamo which in its turn supplies current to a number of small electric motors.

That even the most humble workman may derive profit from the use of machinery is strikingly shown by the accompanying photograph of a clever scissors-grinder who has recently fitted his grindstone with a gasoline motor enabling him to carry out his work more rapidly and efficiently than his competitors. Not only does the engine propel his machine, but it also turns his grindstone for him.


Scissors-grinder's home-made motor car and power grinder.

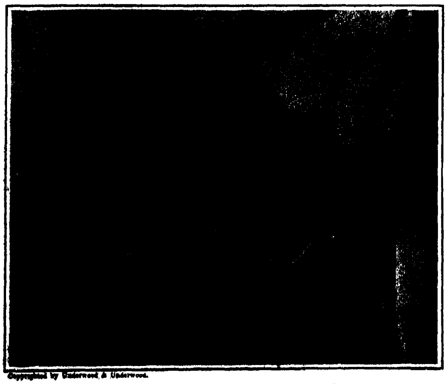
England's Oldest Fire Engine

PICTURED in the accompanying engraving is a relic of early fire-fighting apparatus, which is claimed to be the oldest fire engine in England It is kept in the verger's vestry in Malmesbury Abbey The engine is said to have been built in the year 1700, and saw nearly a hundred and fifty years of service It was last used at a fire in Burton Hill House in 1845. In those days things were built to last and machines were not scrapped, until beyond repair. As the photograph clearly shows, it is a hand-pump adapted to draw water from tanks at either side of the pump cylinder, which was located at the center of the machine These tanks were kept filled by a bucket brigade

Fire engine of the eighteenth century.

The 14-inch Guns of the "Texas" and "New York"

ON opposite sides of one of the piers at the Brooklyn Navy Yard, and exactly abreast of each other, are the two latest additions to our Navy, the dreadnoughts "New York" and "Texas," the former built by the Government at the Brooklyn yard, and the "Texas" recently from the hands of her builders at Newport News Both ships are receiving their finishing touches before sailing for Mexican waters The most interesting and novel feature about these ships is their main armament, which, in the case of each ship, consists of ten 14-inch guns. The 14-inch gun has never before been mounted on a ship of our Navy. Preceding the "New York" and "Texas" were the "Wyoming" and "Arkansas," and each of these ships carries twelve 12-inch guns in six turrets. Although the "New York" and "Texas" carry less guns by two, they have a heavier broadside, for the increase of two inches in the caliber means a very large increase in the power of the guns The 45-caliber, 12-inch gun fires a shell weighing 870 pounds with a muzzle energy of 48,984 foot-tons, and it can penetrate 15.2 inches of Krupp armor at 10,000 yards. The 50-caliber 12-inch gun, which is, of course, five feet longer than the one just mentioned, fires an 870-pound shell, with a muzzle energy of 61,644 foot-tons, and it can penetrate 15.6 inches of armor at 10,000 yards. The 45-caliber 14-inch gun fires a 1,400-pound shell with a muzzle energy of 65,687 foot-tons, and at 10,000 yards it will penetrate 15.9 inches of Krupp armor. The penetration, it will be observed, is very little greater than that of the 12-inch, but the bursting charge of high explosive contained in the 14-inch shell is very much larger.


Copyrighted by Underwood & Underwood.

The forward 14-inch guns of the "New York."

The Heavens in May

The First Comet of 1914, and Its Orbit

By Henry Norris Russell, Ph.D.

THE first comet to be discovered in 1914 was detected by Dr Kritzinger of Bothkamp, Germany, on March 29th It was then on the borders of Scorpio and Ophiuchus, in 16 hours 12 minutes right ascension and 9 degrees 30 minutes south declination, was moving northeastward about 1 degree a day, and was visible in a small telescope. Further observations were promptly secured, and the elements of the orbit have been calculated by Prof Crawford and Miss Levy of the University of California, and by Prof. Kobold of Kiel. The two sets of elements are in very close agreement, and show that the comet will be nearest the Sun on May 31st, at a distance of 1.255 astronomical units, or 117 million miles. It is moving around the Sun in the same direction in which the planets go, and the plane of its orbit is inclined only 25 degrees to that of the ecliptic

The circumstances of its apparition are shown in the accompanying diagram. The comet's orbit must be supposed to lie above the plane of the paper on the left of the line of nodes, and below it on the right—its greatest height above this plane being equal to about half the diameter of the Earth's orbit. The positions of the comet and the Earth at the beginning of each month are joined by lines drawn on the diagram It is easy to see why it was not discovered earlier, for, a month or two before it was first seen, it was farther from the Sun and Earth (and hence much fainter) and also much farther south in the heavens

All through April the Earth gains on the comet, while the latter approaches the Sun, and the combination of these changes causes a rapid increase in its brightness

During May it will be at its best; then it will slowly recede from us and from the Sun, and gradually fade away, though it will be brighter than it was at the time of discovery until the end of August.

The best available ephemeris of its motion now at hand stops on April 30th, on which date its predicted position is in 18 hours 6.5 minutes right ascension and 15 degrees 18 minutes north declination. At this time it is moving 4 minutes eastward and 1 degree northward per day, and its rate of motion is gradually increasing. Allowing for this, it appears that on June 1st it will be in about 20 hours 20 minutes right ascension and 46 degrees north declination; but these are only rough estimates. Its path among the stars lies in Hercules, Lyra, and Cygnus. On May 15th it will be about half-way between β Cygni and β Lyrae.

At the time of discovery it was visible, though not conspicuous, in a small telescope. It will be five or six times as bright as this in May, but it is not at all likely to be visible to the naked eye. Even at the time of discovery, it showed a very faint tail, 40 minutes in length, and when nearest the Sun it will doubtless have a longer one, and be a pretty telescopic object.

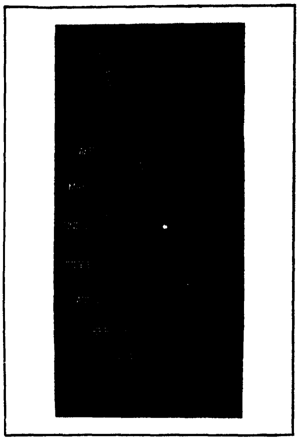
Delavan's comet, which is still behind the Sun, and almost unobservable, was brightening up rapidly when last seen, and will probably be conspicuous in the autumn

The Heavens.

The student of our evening skies may well begin this month by looking right overhead. There, so high that at a first glance he seems almost in the zenith, is the great red star Arcturus, one of the most splendid objects in the heavens. He is conspicuous to the eye for three things, his great brightness, his isolation—no other star at all comparable in brightness with him being within 30 degrees distance—and his red color Viewed with the telescope his brightness and color are, of course, far more impressive; but, even with the most powerful instruments, he remains but a point of light, showing no sign of duplicity, either to direct observation or to the spectroscope. Measurements of his position in the heavens show, however, that he is moving southwestward among the other stars, at the relatively very rapid rate of 2.28 seconds per year. Since the time of Ptolemy, he has moved through more than a degree. This may seem a very small change to happen in 1800 years; but when we pass from the apparent to the real motion of the star, we come upon a speed which no one could call slow.

The parallax of Arcturus, according to the final result of the long series of measurements made at Yale, is 0.075 second. That is, its distance is 2,750,000 times that of the Sun, or 43 light-years, and we see it now as it was in 1871.

Upon computing its actual rate of motion, we find it to be 90 miles per second, or in more familiar units, 324,000 miles per hour. Spectroscopic observation shows that this motion is almost exactly at right angles to our line of sight toward the star; the rate at which it is approaching us is between two and three miles per second



Orbit of Kritzinger's comet.

If removed to the distance of Arcturus, our Sun would appear as a star of the fifth magnitude, just comfortably visible to the naked eye. Even the dazzling Sirius, if set beside Arcturus, would appear as a relatively faint companion, only one fifth as bright as he; for Arcturus is 115 times as bright as the Sun.

Why should this star be so bright? Is it because of its great size, or of high intrinsic brightness of its surface? A pretty definite answer can now be given to this natural question. Arcturus is a red star, and both the color of his light and the behavior of certain lines in his spectrum afford very good reason to believe that his surface is not as hot as the Sun's, though still probably hotter than the hottest electric furnace. If his surface is cooler than the Sun's, it will give out less light and heat per square mile; according to the best estimate we can make, from one third to one fourth as much. But it gives out altogether 115 times as much light as the Sun; so it must have somewhere between 350 and 450 times as many square miles in its surface as the Sun has; that is, its diameter must be not far from 20 times that of the Sun.

Though Arcturus must exceed the Sun in bulk several thousand times, it is very improbable that he surpasses the Sun in mass to at all the same degree. We have no way of getting at the facts in this particular case; but in many similar cases it can be shown that stars of similar brightness, color, and probable diameter contain but a few times as much matter as the Sun. Such stars are of very low density—sometimes not more than that of air—and must be huge masses of rarefied incandescent gas. It may be hard to believe that a mere mass of hot air, however big and hot, could shine far more brightly than the Sun. But air is not quite the perfectly transparent substance that we suppose. Ten miles of it will cut out fully one quarter of the intensity of a beam of light, even on the clearest days; and, at this rate, a thousand miles of air would be practically opaque, and five thousand miles of it would quite conceal the Sun. A ball of gas, millions of miles in diameter, seen from a great distance, would behave like an opaque sphere, except at the very edge, and, if heated, would shine brilliantly.

Below Arcturus, rather to the right, we see Spica, in Virgo, which looks fainter than Arcturus, but must be at least four times as far off, and is really much brighter. Lower down is Scorpio, some of whose stars are still more remote and equally bright or brighter.

Due south, almost on the horizon, appears a part of the southern constellation Centaurus. Its two brightest stars, α and β Centauri, the former our nearest neighbor in space, can now be seen close to the horizon from points in Florida and southern Texas.

Ophiuchus and Serpens fill the southeastern sky, while on the east are Aquila, Cygnus and Lyra, with Hercules and Corona above them. Cassiopeia and Cepheus are low in the north, Draco and Ursa Minor are above the Pole, and Ursa Major is high in the northwest. Castor and Pollux are near setting in the west-northwest, and Leo is higher up in the west.

Hydra, stretching far along the southwestern horizon, brings us back to our point of departure.

The Planets.

Mercury is in conjunction with the Sun on the 17th, and is practically invisible this month.

Venus is evening star in Taurus and Gemini, setting about 8:30 P. M. on the 1st, and 9:25 on the 31st. She is in conjunction with Saturn on the 15th, the two planets being a little more than 2 deg. apart.

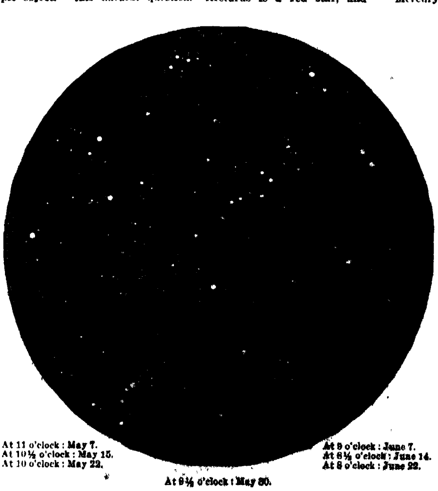
Mars, too, is an evening star, in Cancer, moving steadily eastward, receding from the Earth, and growing fainter, so that he seems now to be only one third as bright as Saturn. He remains in sight till after midnight, except at the end of the month.

Jupiter is a morning star in Capricornus. On the 12th he is in quadrature with the Sun, but being far south does not rise until 1 A. M.

Saturn is evening star in Taurus, setting at 8:30 P M. in the middle of the month. Uranus is in Capricornus, and comes to the meridian about 5 A. M. on the same date. Neptune is in Gemini and is observable in the early evening.

The Moon is in her first quarter at 1:29 A. M. on the 3rd, full at 4:31 P. M. on the 9th, in her last quarter at 5:12 P. M. on the 16th, and new at 9:35 P. M. on the 24th. She is nearest us on the 8th, and farthest away on the 21st. She passes near Neptune on the 1st, Mars (rather closely) on the 2nd, Uranus on the 15th, Jupiter on the 16th, Mercury on the 25th, Saturn on the 26th, and Venus on the 27th, and returns to Neptune on the 28th and Mars on the 30th.

Princeton University Observatory.



NIGHT SKY: MAY AND JUNE

Curiosities of Science and Invention

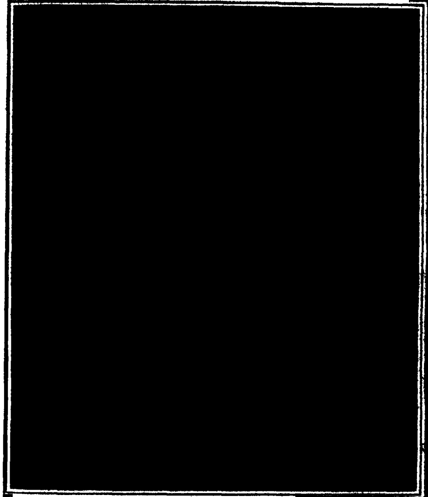
Courtesy of the [illegible]

Motoring over the Ganges.

One of the two curious bridges at Allahabad. The roadway is supported on substantial pontoons consisting of large metal tanks. The bridge accommodates itself to the seasonal rise and fall of the river.

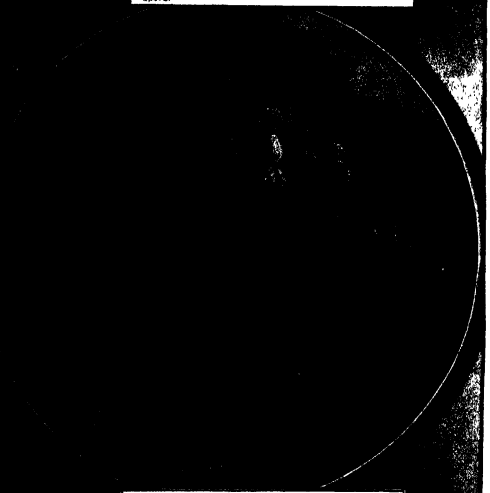
A "boxing glove" side car.

In order to advertise his wares a dealer in sporting goods, in France, has had a motorcycle equipped with a side car built to resemble an enormous boxing glove Quite apart from its advertising qualities, a side car padded like this, should give the passenger a feeling of security when skimming along the road at perilous speed.



Piedro Miguel locks at night.

The locks of Panama will be illuminated with 400-watt tungsten lamps on concrete standards formed with concrete hoods to throw the light on the coping of the lock and the water chamber, while screening the axis of the canal, so that the pilots of vessels entering the locks will be shielded from their glare.



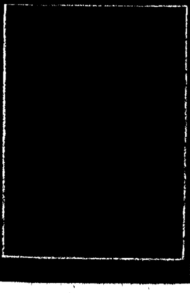
Courtesy of the *Illustrated London News*

Snow plows at work in "sunny" France.

Some very severe weather was experienced in France this winter, not only in the North, but also in the South, which is noted for its mild, sunny climate The photograph depicts a very unusual scene for that region: Two locomotives with snow plows clearing the railroad at Pulchérie, near Carcassonne

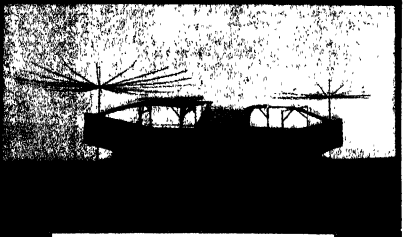
The ingenious milkman.

A dairyman in Los Angeles found it burdensome to carry the heavy cans from the milking yard to the dairy, so he rigged up the trolley system shown in the photograph, which was inexpensive and easily built. The full cans are carried on a heavy wire by a small two-wheel car, and go all the way by gravity.



A parlor car garage.

In order that he may use his motor car at any point along the line, Mr. Louis W. Hill, son of Mr. J. J. Hill, and chairman of the Board of Directors of the Great Northern Railway, has had a garage constructed in one end of his private car.



A twentieth century Noah's Ark.

Anticipating a second great flood a modern Noah is building an ark near Palo Alto, California It is to be a catamaran, which the builder plans to drive by means of four wind wheels connected to propellers. The photograph shows one of the floats. It measures 50 by 17 feet and will draw six feet of water.

ODDS AND ENDS FROM THE EDITOR'S DRAWER

New Automobile Headlight

A HEADLIGHT which differs radically from all other automobile headlights, and involves a number of exceedingly interesting new features of construction and manufacture, has been invented by Edouard Cannevel, whose "Eyeball" headlight and ingenious carbureter have already appeared in this country and have been adopted by several manufacturers of automobiles.

The new headlight embodies a peculiarly shaped reflector, which is claimed to give remarkable results with an ordinary six-candle-power lamp on an automobile. Tests with the new reflector have shown its power to be greater than that of any other reflector at present manufactured.

As will be seen from the accompanying illustrations, the reflecting device consists of a series of annular, parabolic sections in combination with a curved mirror. Light rays are thrown from the lamp sideways toward the parabolic rings and by them reflected into the mirror behind the lamp. They increase those light rays sent directly from the lamp into the mirror and into the roadway ahead. In this manner the large amount of light "lost" through uncontrolled reflection from the side walls of the headlight is utilized for roadway illumination.

In order to be able to manufacture a silvered reflector of the kind used in this headlight, the inventor had to design a special apparatus, which is shown in another illustration. It consists of an air-tight bell, from which the atmosphere is exhausted and in which a small quantity of hydrogen is liberated. Mounted upon a pivot in the center of this bell is the reflector, carrying at its upper end a magnetized bar. The reflector revolves easily between two electric poles. Revolvably suspended above the bell is a huge magnet which by its drag causes the magnetized bar inside the bell, and with it the reflector, to revolve upon its pivot. The silver to be deposited upon the reflector is volatilized by an electric current of 60,000 volts at the poles and deposited upon the glass of the reflector.

In order to protect the silver from the atmosphere and its oxidizing influence, a special protecting surface of copper is subsequently deposited upon it by means of a metal spraying process.

The Marvels of Ultra-violet Radiation

By Richard Arapu

THE English novelist, Wells, in his "War of the Worlds," describes the invasion of the earth by armless, legless, tentacled, and megalocephalic Martians, who destroy men, houses, forests, and fields by directing upon them fluorescent green rays, that ignite and consume everything that they touch.

Radiations as remarkable and almost as destructive as these imaginary Martian rays have been studied in physical laboratories in recent years These are the ultra-violet *rays*, which exist in *sunlight*, and which are produced abundantly by the quartz mercury vapor lamp.

Prof. Daniel Berthelot of the *Ecole Supérieure de Pharmacie*, who has made a profound study of these rays, said recently to the writer:

"The ultra-violet rays are the most rapid ethereal radiations that we are able to produce. This quartz lamp emits rays that vibrate 750 trillion times in a second. This prodigious number exceeds our powers of comprehension Our eyes are blind to these too rapid vibrations as our ears are deaf to sounds too high in pitch Yet, these invisible rays, which are detected by the photographic plate and perhaps by the eye of the ant, exert disastrous action on higher organisms, and especially on man"

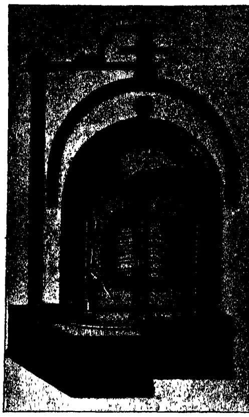
The skin exposed to ultra-violet radiation reddens, inflames and peels These are the effects of sunburn, and sunburn is explained by the abundance of ultra-violet radiations in the sun's rays

"But the eyesight is most greatly menaced by exposure to ultra-violet rays, which in a few seconds produce painful conjunctivitis and ophthalmia. An exposure of three or four minutes may cause total blindness."

This peculiar property of ultra-violet rays may be utilized in future wars. In the recent war in Thrace many nocturnal attacks were made by Bulgarian troops armed with acetylene torches, the dazzling light of which blinded the enemy and made defense impossible. The invisible ultra-violet rays can be filtered from the green light of the mercury vapor lamp by a screen of suitable material and color, and it would be easy to devise apparatus which would emit a flood of these invisible destructive rays that would actually blind the enemy.

But these rays have other wonderful properties that suggest more peaceful applications.

"The ultra-violet rays," Prof. Berthelot continued, "make foodstuffs out of the gases of the atmosphere. Under the influence of these rays carbon dioxide and water vapor combine to form sugar and other carbohydrates. Hence, it is not too rash to look forward to the synthesis of certain foodstuffs. Theoretically, we may foresee the replacement of some of our fields of grain and sugar beets by factories in which food will be produced from the atmosphere by the agency of ultra-violet rays. The engineer, the physician and the chemist will then take the place of the farmer.



Apparatus with which the new reflector is silvered.

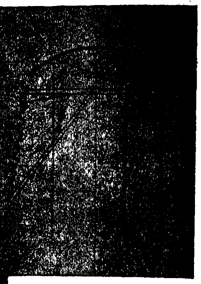


Diagram illustrating the paths of rays in ringed reflector.

"At present a kilogramme of sugar could not be produced in this way for sixty or seventy centimes. It would cost several thousand francs. But it cost Sainte-Claire Deville, the discoverer of aluminium, several hundred francs to produce a kilogramme of the metal, while pure aluminium is now worth less than two francs per kilogramme.

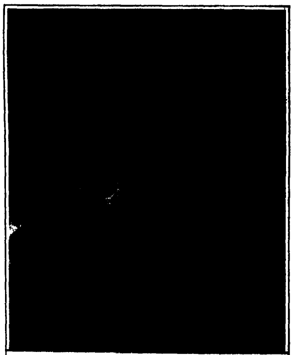
"Science moves so quickly nowadays that the partial realization of the synthesis of foodstuffs is perhaps less distant than some persons think.

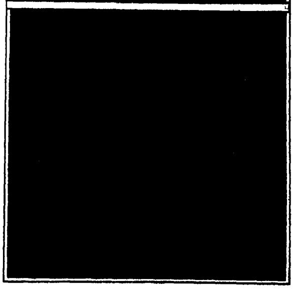
"The ultra-violet rays have also made entrance into the realm of the ferments, those mysterious leavens on which some of the oldest and most important of human industries are based. I have inclosed foodstuffs—sugar, butter, and fats—in sealed vessels of quartz, and have effected their digestion by the action of ultra-violet rays, without the aid of any ferment.

"It seems to me that I have here touched one of the mysterious secrets of life. Food is digested by the action of the saliva, the gastric and intestinal juices, etc., which contain ferments or diastases that decompose the foodstuffs into substances that the body can assimilate. I have digested artificially by the agency of ultra-violet rays, foodstuffs of the three great classes, carbohydrates, fats and albuminoids, inclosed in globes of quartz.

"Perhaps the therapy of the future will make use of internal light baths, and dyspepsia will be treated by introducing into the stomach, instead of capsules of pepsin, tiny lamps that emit ultra-violet rays."

Prof. Berthelot examining a mercury vapor lamp with uranium glass spectroscope, devised by Soret and Cornu for making ultra-violet rays visible.





Prof. Berthelot holding a Billon-Daguerre mercury vapor lamp with double walls, designed for the sterilization of water.

Protective Coatings for Objects Made of Plaster of Paris

PLASTER of Paris reproductions of famous statues can be effectively used for the adornment of pleasure grounds, porches, pergolas, etc. Unfortunately, however, they are very susceptible to the ravages of the weather. *Recettes de la Maison* (*Household Receipts*) recently published formulas for protective dressings for such objects, without, however, discriminating as to their comparative value. Whereupon a contributor to *La Nature* (Paris) undertook to make thorough tests upon this point, the results of which have just been printed. For this purpose squares of plaster, mixed and molded in the ordinary manner, were covered with various coatings and then exposed to all sorts of inclement weather. The first was treated with boiled linseed oil, the plaster being saturated by successive application of 8 or 10 layers. Under this treatment it acquired a pale brownish yellow color, and was hardened almost as much as if it had been subjected to a borax bath. A genuine but not very durable protection was afforded by this treatment, since the plaster subsequently corroded, though very slowly.

The second treatment was of wax, applied by passing a hot iron over the scrapings of wax with which the surface had been dredged. Very little of the wax is absorbed unless the plaster had been previously heated. A beautiful yellow color, slowly growing paler, was obtained and the subsequent exposure left the plaster absolutely unaltered. The third application was of paraffine, which can be applied in two ways. First in the melted state, spread by hot iron, and secondly dissolved in carbon disulphide. This solution better penetrates the thickness of the plaster. In each case the plaster becomes a pale gray in color and the hardness is not modified. Both methods afford very efficient protection. The fourth material used was stearine, scrapings of candle-ends being spread over the surface by a hot iron. The result was a crystalline coating changing the white to pale gray. The protection furnished was excellent.

Finally, a 10 per cent solution of gelatine was used. The plaster absorbs little, because gelatification occurs soon after deposition. Parts of the surface were subsequently coated respectively with alum, bichromate of potash, and formol. In no case was this treatment successful, since the gelatine layer always dissolved or scaled away.

The conclusion drawn, therefore, is that wax, stearine, and paraffine are the best preservatives, and since the last is the cheapest it is probably best for most cases. It may be applied either by heating the surface or dipping the object in a hot bath of the melted substance used.

A Memorial to Benjamin Franklin is to be erected in what is probably the most interesting old church in England, viz., St. Bartholomew the Great, in Smithfield. Franklin worked as a printer in this church, part of which was then devoted to secular uses.

Exploding Mines by Wireless Telegraphy

By Dr. Charles Forbes, Columbia University, New York

THE newspaper accounts that have appeared from time to time in regard to the explosion of submarine mines by means of radio-telegraphy might lead the ordinary reader to believe there is danger of exploding powder magazines on war vessels, and torpedoes and mines located in harbors for defense, in the daily use of the wireless telegraph. Such an event cannot, however, take place without the intervention of apparatus specially constructed for the purpose.

An interesting laboratory experiment illustrative of the subject may be performed as follows: There must be apparatus for generating the electric waves, known as the Hertzian, from their discoverer; also apparatus for receiving the impressions produced by them. Like the telegraph and telephone the transmitting and the receiving instruments are essential. For the laboratory experiment the transmitting apparatus may consist of the usual amateur outfit. In the absence of this the sparks from an influence electrical machine, the induction coil or the Leyden jar will be sufficient to set up the Hertzian waves. In the simplest form the Leyden jar answers the purpose very well. The receiving apparatus consists of the Branly coherer, which is placed in series with a suitable electric battery, two dry cells being sufficient, and a relay, which in action closes a second electric circuit generated by another battery of two dry cells. This current is conducted by communicating wires to the exploding fuse in the mine to be exploded.

Inspection of the illustration will show the wiring and the arrangement of the apparatus for the laboratory experiment. Fig. 1 represents the Leyden jar being discharged by the discharging rods. Electric waves are represented passing outward in all directions ready to impinge upon receiving apparatus situated in their path. Fig. 2 represents the receiving apparatus. The coherer is at *A*, the battery at *B*, the relay at *C*, the relay battery at *D*, and the mine to be exploded at *E*, resting in a tank of water.

On discharging the Leyden jar, this is what takes place: The electric waves thereby generated pass onward through space, and acting on the coherer, its battery is set in operation, thereby closing the relay circuit, which in turn actuates the fuse, when the explosion of the mine is effected.

The essential part of the receiving apparatus is the coherer. The details of its construction are represented in Fig. 3. A glass tube about 2 inches in length is represented at *F*. Into this there are fitted rather snugly, brass or copper rods *G*; the internal ends being separated about one eighth of an inch and the external ends having metal disks attached, somewhat larger than those represented in Fig. 2. The space between the internal ends of the rods is to be nearly filled with filings of nickel about 9 parts and silver 1 part. If the pure metals are not available for the filings nickel and silver coins may be substituted. A trace of mercury, which is desirable, may be secured by amalgamating the internal ends of the rods in the glass tube. The coherer has this peculiar property; the filings, in the inactive condition, offer a high resistance to the passage of a battery current of electricity; when acted upon by the electric waves they are said to cohere, offering much less resistance, thereby allowing a much greater electric current to pass. This is sufficient to actuate the relay.

The miniature mine to be exploded is represented in Fig. 4, about the actual size. It consists of a metal tube with a rubber stopper inserted at its upper end and another at the lower end. Through the lower stopper the insulated conducting wires from the relay battery pass. The terminals are connected by a fine iron or platinum wire, which is imbedded in the gun powder in the inclosed chamber. The fine wire on becoming incandescent ignites the powder and the explosion takes place. Interest will be added to the experiment if, preceding the explosion of the miniature mine, the closure of the relay current be made to ring an electric door bell, and if by tapping the coherer, the ringing may be discontinued. In a similar manner electric lights may be lighted on substituting the electric light current for the relay battery current. In actual practice the sending apparatus of the wireless telegraph would be used to set the ether waves in motion and the submarine mine would be attached directly or indirectly to the receiving apparatus. From the above described experiment, it is quite evident that the accidental explosion of mines and other magazines of explosives by means of the Hertzian waves is very improbable. An explosion by electrical induction would be a very different thing, and could only take place at a distance of a few feet. For its occurrence, specially arranged apparatus would also be necessary.

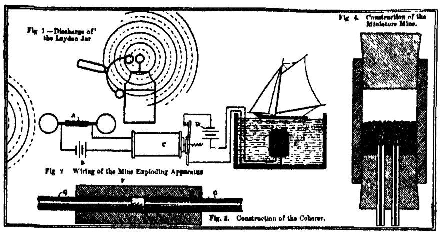


Fig 1.—Discharge of the Leyden Jar
A
B
C
D
Fig 2 Wiring of the Mine Exploding Apparatus
F
G
G
Fig. 3. Construction of the Coherer.
Fig 4. Construction of the Miniature Mine.

Experimental apparatus used to illustrate the exploding of a submarine mine by wireless telegraphy.

A New Experiment to Determine the Earth's Rigidity

A NEW and improved method for determining the rigidity of the earth has recently been devised by Prof. A. A. Michelson, director of the Ryerson Physical Laboratory of the University of Chicago.

The method consists essentially in measuring with great accuracy the tides in two steel tubes half filled with water. The tubes used in this experiment are of steel, each 500 feet in length, lying horizontally upon solid concrete foundations in trenches six feet deep, and are carefully insulated against temperature changes and other outside disturbances. They are placed at right angles to each other, the one in a north-south direction and the other in an east and west line The water in the tubes communicates with chambers at the ends, where, by an ingenious arrangement, the change in level, i. e., the deviation from the true level due to tidal action, can be measured to a ten thousandth of an inch.

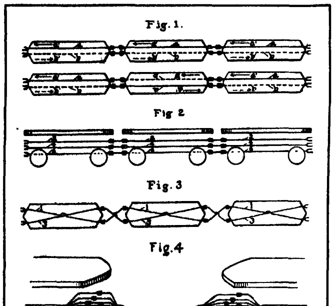
The object of thus producing tides in a closed tube is to eliminate as far as possible the unknown factors that play a part in natural tides, such as contours of coast-line, wind, ocean-currents, meteorological conditions, etc. The tide in these tubes is the resultant of two main factors; the deformation of the earth due to the attraction of the moon and the tractive force exerted by the moon on the water directly. This latter force can be calculated mathematically, and by subtracting this calculated amount from the tide actually observed the component due to the earth's distortion is found. Knowing the force exerted by the moon on the earth, and the amount of deformation produced by this force, the rigidity of the earth can be calculated.

The actual computations are far from simple, however, as the forces exerted by all the larger planets must be considered and various complicated correction factors must be introduced.

Arrangement of Wires in Multiple-unit Trains

By Samuel W. Balch

THERE are a number of pretty geometrical problems in the arrangement of the train signal wires which run through the multiple-unit trains for controlling the operation of the electric motors on the different cars. In order to understand the arrangement, it will be sufficient to assume that the motors and their controllers have seven speed arrangements, each of which can be brought about by turning current into the corresponding speed-signal wire, and the motor arrangements will be made the same on all the cars. In addition there are two direction positions which require two additional wires.



How the signal wires for controlling the motors of multiple-unit trains are arranged.

In the multiple-unit system these positions are selected by nine signal wires running through each car and coupled together where the *car platforms meet*. They are connected on each car to magnets, which need not be described here, so that if one of the speed wires and one of the reverser wires have current turned into them the same driving conditions will be set up on all the cars A peculiar difficulty arises first from the fact that the direction in which a car will run with a given position of its reverser is a direction with respect to the car itself and not with respect to the points of the compass, Thus, if a car were taken from the main track on a Y switch and returned on the other branch of the Y, it would be turned around and the position of the reverser, which originally stood for north movement, would now stand for south movement To prevent a car which has thus become turned end for end in a train from being at cross purposes with the other cars, the signal wires have simply to be run through the train parallel and in the same horizontal plane

In Fig 1 two trains are shown with the reversing signaling wires In the second train the middle car is turned end for end. Turning current into signal wires *a a* sets the reversers on all the cars to run in the directions shown by the arrows *a' a'*, and turning into the signal wires *b b* sets the reversers oppositely. When the middle car is turned end for end and the wire *a* is given current at the head car, the wire *b* receives the current on the middle car and returns it to wire *a* on the rear car Simple as this arrangement is, several of the first inventors of train lines do not show it in their patents.

The speed controlling wires require to be connected, wire 1 to wire 1, wire 2 to wire 2, and so forth, no matter how the cars are brought together into a train in whatever end to end relation or order There are two ways of insuring this One way is to put them on different levels and in the same vertical plane as shown in Fig. 2. Another is to leave them on the same level as in the case of the reverser wires, but the train wires must be crossed as shown in Fig. 3 The connections however must be crossed back again in the jumpers between cars If only the wires through the cars were crossed, connections would still be kept right in case a car should be turned end for end, but wires 1 and 3 would be in exchanged positions in the odd positioned cars of the train as compared with the even positioned cars of the train, and a car wired for position 1, 3 or 5 could not be used in position 2, 4 or 6. The difficulty is overcome by the crossings in the jumpers These are in effect extra sections of the train line so that the train line sections on the cars are only the odd numbered sections. The detachable sections between cars are necessary in the form of the flexible jumpers as shown in Fig. 4 to conform to the flexibility of the train. Each set of terminals is brought together in a head so that the coupling of all can be performed at one operation, and the three systems described are combined to secure a compact arrangement of the nine terminals. This arrangement at one end of a car or jumper is as in Fig 5, and at the other end as in Fig. 6

As in practice there is no room for the coupling at the center line of the train, the couplings are repeated on both sides, either of which is coupled according to convenience. The wires, however, can have the same arrangement as for the center line, and this plan is followed in all multiple-unit installations

Where two train lines thus become necessary, a simpler solution is possible, in which all the wires are run parallel in each train line, but in right and left arrangement in the two lines. This was the case in the first multiple-unit installations by Frank J Sprague, but it was not known to the engineers who developed the system at present in use. Other ways of doing this are shown in patents No 405,897, June 25th, 1889, Harry W. Leonard; No. 660,065, October 16th, 1900, Frank J. Sprague.

Who Will Imitate Jeffery Next Year?

Wide public endorsement has been given to the idea which Jeffery brought over from Europe last fall—the high speed, light weight, economical, four cylinder motor. He it was who first put this dominant idea into American practice—produced the first light weight economical, high grade Four to sell at $1550.

There are persistent reports that other makers will pay tribute to Jeffery by producing cars of a similar type—next year. Imitation is, indeed, the most sincere flattery and we welcome this imitation with hearty good will.

The unmistakable demand for light weight and economy has become so pronounced that engineers do not hesitate to publicly endorse the idea which has made the Jeffery a big success.

It is well known that the biggest successes of the industry have been founded upon cars of this type. Yet, during the past two years, the tendency towards heavy weight in design became so pronounced that people who valued economy, light weight and low upkeep expense were forced to buy low priced cars.

For two years there was little improvement in the design of motor cars except in body details and such features as starting devices. Then a great wave of economy spread over the country. People were forced to take inferior quality, scant comfort and sacrifice appearance to realize economy.

Jeffery saw that the industry was traveling in the wrong direction. He sent his engineers to Europe, where the best makers have already had the same experience which most American makers must yet go through. The high speed motor is dominant over there—it has made good. Jeffery brought that idea to America. Then he built the Jeffery Four at $1550 and the Jeffery Six at $2250. Power he attained through speed instead of bulk.

In five months orders have been taken for seven thousand Jeffery cars.

Now the light, economical car has won the victory. The big sale of Jeffery cars is evidence enough of that. Our shipments during the first three months of the year exceeded those of last year by 103 per cent.

Read the clipping from Motor Age opposite and you have concrete evidence of what will certainly be the dominant type in years to come.

The Jeffery Four represents that dominant type.

The leading trade papers are commenting every day upon the superiority of the small, high speed motor. Jeffery introduced that type into America last fall.

It is quite likely that other light Fours will be built, but we do not fear this competition because there is embodied in the Jeffery Four the best material that the market affords and the best ideas developed by the best mechanics in the world.

Fortunately, Jeffery is in the best position to meet the keenest competition. He has no stockholders to satisfy. He is the one man in the United States who controls a complete automobile factory and every dollar's worth of equipment is paid for. He discounts all bills. Therefore, he is able to buy right. He is satisfied with a small profit. Therefore, he can build the best four cylinder car in America and sell it at a price which cannot be duplicated by manufacturers lacking his capital, equipment and experience.

Here are the specifications which gave Jeffery leadership in sales after he attained leadership in ideas.

SMALL HIGH SPEED MOTOR, introduced by Jeffery November, 1913.

IMPORTED ANNULAR BALL BEARINGS—endorsed by cars selling above $4,000—adopted by Jeffery.

RAYFIELD CARBURETOR—endorsed by dealers—adopted by Jeffery.

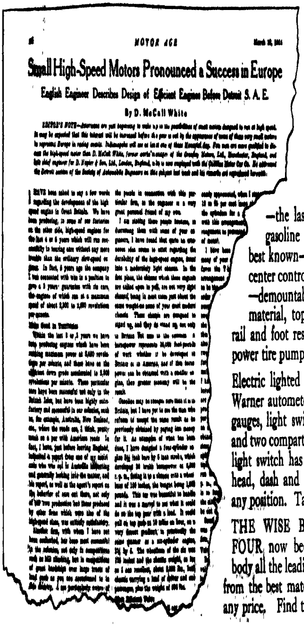
VANADIUM STEEL SPRINGS AND AXLES—endorsed by everybody—adopted by Jeffery.

FOUR SPEED TRANSMISSION—demanded by the public—adopted by Jeffery.

MOST EXPENSIVE FULL FLOATING REAR AXLE—most costly—most quiet starting and lighting system—most expensive body in design and finish—Spicer universals—the last word with mechanics—pressure feed gasoline tank—Neverleek top—oiling system best known—Bosch Duplex ignition—left steer and center control—cone clutch—wheel base 116 inches—demountable rims—equipment—top made of best material, top cover, rain vision windshield, robe rail and foot rest—Klaxet horn, Solar electric lamps, power tire pump and complete tool equipment.

Electric lighted auxiliary dash, on which is mounted Warner autometer, ammeter, gasoline and oil pressure gauges, light switch, coil switch, electric horn button and two compartments for valuables. The one electric light switch has four positions to operate—the side, head, dash and tail lights. Switch can be locked in any position. Tail light and dash light work on relay.

THE WISE BUYER WILL GET A JEFFERY FOUR, now because next year his car will still embody all the leading construction principles. It is made from the best materials that can be put into any car at any price. Find the nearest Jeffery dealer today.



MOTOR AGE

Small High-Speed Motors Pronounced a Success in Europe

English Engineer Describes Design of Efficient Engines Before Detroit S. A. E.

By D. McCall White

The Thomas B. Jeffery Company

Main Office and Works, Kenosha, Wisconsin

RECENTLY PATENTED INVENTIONS

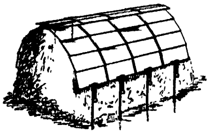
These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

HAT BRIM PRESS.—F. HUSS, 68 Wooster St., New York, N. Y. This invention provides means for stretching the brim while in the press and under control; and provides power means manually operable for exerting an extra pressure upon the material forming the brim, said means being controllable to conform to the inherent conditions of various materials.

Of Interest to Farmers.

HAYSTACK COVER.—F. A. FREELAND, Athelstan, Iowa. This invention has special reference to novel and useful improvements in covers for haystacks The primary object of the invention resides in the provision of an improved cover which will automatically adjust itself to a stack as the latter settles, whereby the stack will not only be protected, but the cover will be prevented from blowing loose in case of high winds The accompanying illustration is a perspective view of the improved self-adjusting haystack cover applied to a stack.



HAYSTACK COVER.

SWEEP RAKE.—W. H. SELLERS, JR., Florence, Kan. The purpose of the invention is to provide the teeth of the sweep rake with means whereby the hay may be sufficiently compressed and packed on the stacker as to prevent it from falling away with the sweep rake when the latter is withdrawn.

COTTON PRESS.—J. H. BODDIE, 802 S. 6th St., Muskogee, Okla. An object here is to provide a dog locking and releasing means for the revolving press boxes whereby the cotton after compression by the tramper is held during the revolving of the box from its receiving position under the tramper to its transfer position under the ram and under the compressing and baling box. At this point the dogs are automatically released so as to allow the ram to raise the partially compressed cotton in the compressing and baling box.

AUTOMATIC HAY-EJECTOR FOR SWEEP RAKES.—B. F. LEWIS and J W LEWIS, Hartland, Kan. Address E. R. Shorpe, Larkin, Kan The present invention is an improvement on the patent granted to these inventors, No. 1,038,168 In the latter the hay ejector or hay pusher is required to be adjusted manually by the driver of the rake in order to throw it into and out of action, whereas in the present, the action is entirely automatic, thus effecting a considerable saving in time and expense.

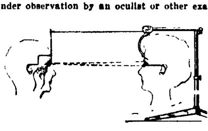
ROPE TAKE UP.—J. C. WILLIAMSON, Cordele, Ga This device is for use in stump pullers and like machines, wherein a take-up or tie is provided for connecting the stump to the pull rope, so arranged that after the stump has been pulled, the take up or tie may be released from the pull rope, and removed to another stump, and without interfering with the operation of the pull rope as it pulls the succeeding stump

WEED PULLER.—D GOTTFRIED, Quindan Station, Kansas City, Kan This device is capable of being held in the hand, and has means for grasping and holding the weeds so arranged that the weeds may be grasped lengthwise of the stalk and beneath the surface of the ground if desired

STEERING DEVICE FOR CULTIVATORS.—A T HOLMES, St. John, Wash The more particular purpose of the invention is to enable the operator to cause the cultivator to make a comparatively short turn, thus occupying a minimum of room for the purpose and also enabling the turning movement to be easily executed.

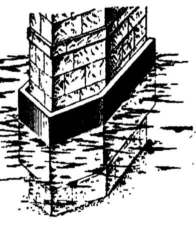
Of General Interest.

OPTICAL INSTRUMENT.—W WORK, care of Herman S. Hewett, 110 Main St., Brockton, Mass This instrument is for use in conjunction with a plano retinoscope, arranged to permit of quickly and accurately determining the amount of refraction of the eye of a patient under observation by an oculist or other examiner, to insure fitting the patient with eyeglasses or spectacles having correct spherical, cylindrical or compound lenses. To accomplish the desired result use is made of an indicator and controlled by the examiner during the use of the plano-retinoscope.



OPTICAL INSTRUMENT.

PIER PROTECTOR.—S. C. MAY, 880 Tenth St., Modesto, Cal. Means in this invention provides protection for bridges, piers or the like from damage due to floating logs, ice or débris carried by currents of water. Among the objects, therefore, of this inventor is to provide a means of a simple and permanent nature adapted to be secured to or arranged in association with a pier or the like projecting into or upwardly from a body of water, said device being so arranged with respect to the pier as to float upon the surface of the water whereby it will always be automatically maintained at proper elevation with respect to said surface.



PIER PROTECTOR.

SHAVING AND LATHER BRUSH.—D. I. HARTMANN, 137 Regent Place, Brooklyn, N. Y. This invention includes a handle, a set of bristles and a massager carried by the handle and located within the mass of bristles,, the arrangement being such that the bristles may be used as usual for the application of soap to the beard and then for the massager to be brought into use by a slightly greater pressure upon the handle for the purpose of forming the lather directly upon the face without the operation of the fingers.

BEARING.—C. G. LUNDGREN, 210 Adams St., Chicago, Ill The purpose here is to provide a bearing which may be used on grinding wheel heads, and to provide solid tapering bearing members, which are adjustably secured to the heads, so that they may be moved longitudinally when slightly worn, to fit snugly the tapering portion of the spindle carrying the grinding wheel

LOOSE LEAF BINDER.—W. C. TRAHER, London, Ontario, Canada. The covers are manufactured rapidly and complete before the locking hooks are secured in place. They may be passed through rollers in the last stages of manufacture, which could not be done if the hooks were secured to the covers before the latter were completed. Plates for the hooks are corrugated, which permits of the use of very cheap metal, wires being provided, the central portions of which are clamped by the plates with wire terminals bent to form hooks. Each corrugated plate has bent spring flanges, which engage the companion plates for holding the plates in position when their outer edges are slid within the flanges of the spring plate which is secured to the covers after their completion.

COMBINATION REINFORCING ROD AND WALL PLUG.—J MCLOUGHLIN, Glen Cove, N. Y. This invention relates to devices used for supporting the molding board or planking of any kind on a brick or concrete wall; and has reference more particularly to a device comprising wooden wedges at a predetermined distance from one another, having an edge flush with the wall incorporating the same.

CABLE GUIDE.—H. HOLMES, Noyo, Cal. In the present patent the invention has for its object the provision of a cable guide inexpensive to manufacture and one having a free movement for use in directing the cable as may be desired and under all conditions of operation.

LUMBER JACK.—C. E. EVANS, Weed, Cal. The jack has a yoke with a stud journaled in a supporting arm, and studs carry a member having teeth for engaging the lumber. The teeth are inclined to adjust the yoke relatively to the supporting arm to hold the yoke so that the teeth will be inclined as desired relatively to the supporting arm. Pins extend from the teeth member to limit the latter's movement. A collar is held in adjusted position relatively to the stud by a cotter pin, this collar being provided with a flange for engaging the supporting arm to check the rotary movement of the yoke relatively thereto.

HORSE OVERSHOE.—C. E. DEUSCHER, 228 St Ann's Ave., Bronx, N. Y., N. Y. This device is adapted to be easily attached to or removed from the hoof, and is provided with gripping devices of peculiar construction adapting them in a superior degree to the making of a sure hold upon the ice, and may be readily replaced if worn out or broken.

MUSIC HOLDER.—E. J. BABBITT, Onaway, Mich. This holder comprises a base and a music supporting frame provided with means for engaging beneath the front board of a piano, the base and the frame slidably and frictionally connected to permit relative adjustment of the frame when the base is in engagement with a fixed support, and of the base when the frame is engaged with a piano.

GREASE CUP.—E. H. [illegible], 1777 Broadway, New York, N. Y. The improvement provides a base adapted to be secured adjacent a bearing, said base having a delivery tube, and means for quickly attaching thereto a cup filled with grease, special means being provided to prevent a loss of said cup from the base or any tendency for the parts to rattle when in use.

MOTOR.—B. STEWART and D. B. STEWART, Garden City, Kan. This water motor is adapted to be arranged in a flowing stream, and is provided with vanes for engagement by the water to rotate the wheel, so arranged that on one side of the wheel the said vanes will automatically take a position at approximately right angles to direction of the flow, and on the other side will automatically take a position approximately parallel with the direction of flow to offer the slightest possible amount of resistance to said flow.

DETACHABLE HORSESHOE CALK.—G. I. DE FORCE, Erie, Pa. This calk is one which is capable of quick attachment and detachment, which may be attached without loosening or removing the shoe, which will not engage the hoof of the horse nor incommode the horse in any way, which will fit any shape hoof, and which is so arranged that the greater the strain the more tightly the device grips the shoe.

Hardware and Tools.

KNIFE AND SCISSORS SHARPENER.—A. HELMER, 826 53rd St., Brooklyn, N. Y. This inventor provides a device designed to be adjusted so that either a knife or pair of scissors may be sharpened by an unskilled person. It provides a pair of abrading rollers and means for locking the same in adjusted position, together with means for guiding the blades of a pair of scissors against one of the rollers.

SAW JOINTER.—WILLIAM E. GIBBS, care of W. L. T. Co, Oak Point, Wash. The device of this patent provides a novel arrangement of adjustable members and gage elements designed to provide a simple construction permitting of a wide range of adjustments to adapt the tool to the various operations of jointing, filing, and swaging, and enable the same to be performed with facility and accuracy.

COMBINATION TOOL.—L. KALINA, 132 Nassau St., New York, N. Y. The inventor provides a combination tool embracing a key ring, scissors, button hook, cigar cutter, and bottle opener, and arranged to take up very little space when the several devices are in folded position, thus allowing of conveniently carrying the combination tool in a vest pocket.

TOOL.—J. E. W. BOSSCH, care of Overbeck Bros., Columbus Ave. and 82nd St., New York, N. Y. The invention provides a tool having a pivotally mounted member on the end, and a reciprocating or removable hammer structure for locking the pivotally mounted portion of the tool in various adjusted positions so as to cause the same to act as a hammer, a wedge, tack puller, box opener, etc.

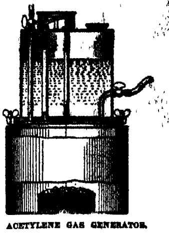
ASSEMBLING SOLDERING TOOL.—J. E. EBAUGH, 215½ W. Reed St., Moberley, Mo. This tool is especially adapted for holding two parts in assembled relation so as to be soldered or otherwise united, the tools being in the nature of pliers designed for use by jewelers, opticians and the like for conveniently holding broken parts together while being soldered.

Heating and Lighting.

SUPERHEATER.—E. J. AKINS, Moundsville, W. Va. The invention provides a device for utilising the waste heat from a traction engine or similar machine, for superheating the exhaust steam and again utilising the same in any desired manner, as for instance in a low-pressure cylinder.

SECTIONAL STEERING WHEEL.—L. E. LAURANCE, Stites, Idaho. This invention is in sectional steering wheels, and like hollow bodies, and provides a hollow body consisting of separable sections and having partitions separating the interior of the hollow body into compartments, sundry of these having openings covered with transparent coverings, the hollow bodies being adapted to contain heating and illuminating devices for heating the hollow body and for illuminating objects near the said body.

ACETYLENE GAS GENERATOR.—E. W. HOLLINGSWORTH, Columbia, S. C. The carbid is first put in and the tank secured to a casing by bolts. Water is introduced into the tank through an opening, after which the screw cap is placed in position. As water flows through the openings it drops down upon the carbid and acetylene gas is generated. As the water flows into the casing, air is drawn through an opening to take the place of the water. As gas pressure rises it forces the piston upwardly, thereby causing a needle valve to shut off the flow of water through the medium of a lever. The gas is used by connecting the feeding device with a stop cock. By connecting to the stop cock part of the gas may be used for lighting purposes. Pressure decreasing sufficiently within a [illegible] the needle valve to again permit water to [illegible] access to the carbid and the gas will [illegible] to generate again. Thus, action of the generator is automatic.

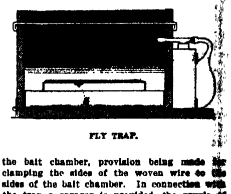


ACETYLENE GAS GENERATOR.

Household Utilities.

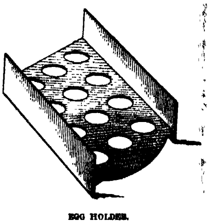
TOWEL HOLDER.—J. E. ADAMS, Box [illegible], Loveland, Ohio. This improvement relates to a towel roller, and particularly to a roller having a novel means for securing the same at one end to a suitable support, there being a novel arrangement of bearings for a [illegible] center rod on which the roller revolves.

FLY TRAP.—C. H. CURTIS, Bluffton, [illegible]. In carrying out the invention a trap chamber is formed of woven wire or equivalent [illegible] or openwork material, and is arranged above the bait chamber, provision being made for clamping the sides of the woven wire to the sides of the bait chamber. In connection with the trap a sprayer is provided, the nozzle of which is so arranged that a spray of insecticide to destroy the flies may be directed into the trap chamber.



FLY TRAP.

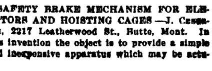
EGG HOLDER.—C. S. WEBER, 10 De[illegible] St., New York, N. Y. This holder stores eggs in ice boxes, provision chests, in pantry shelves, and the like, and is arranged to safely hold a dozen or more eggs in a comparatively small space, to allow of conveniently placing the holder with the eggs thereon into a household receptacle or onto a shelf and to protect the eggs against injury by other articles when placing the latter into an ice box or removing the same therefrom.



EGG HOLDER.

Machines and Mechanical Devices.

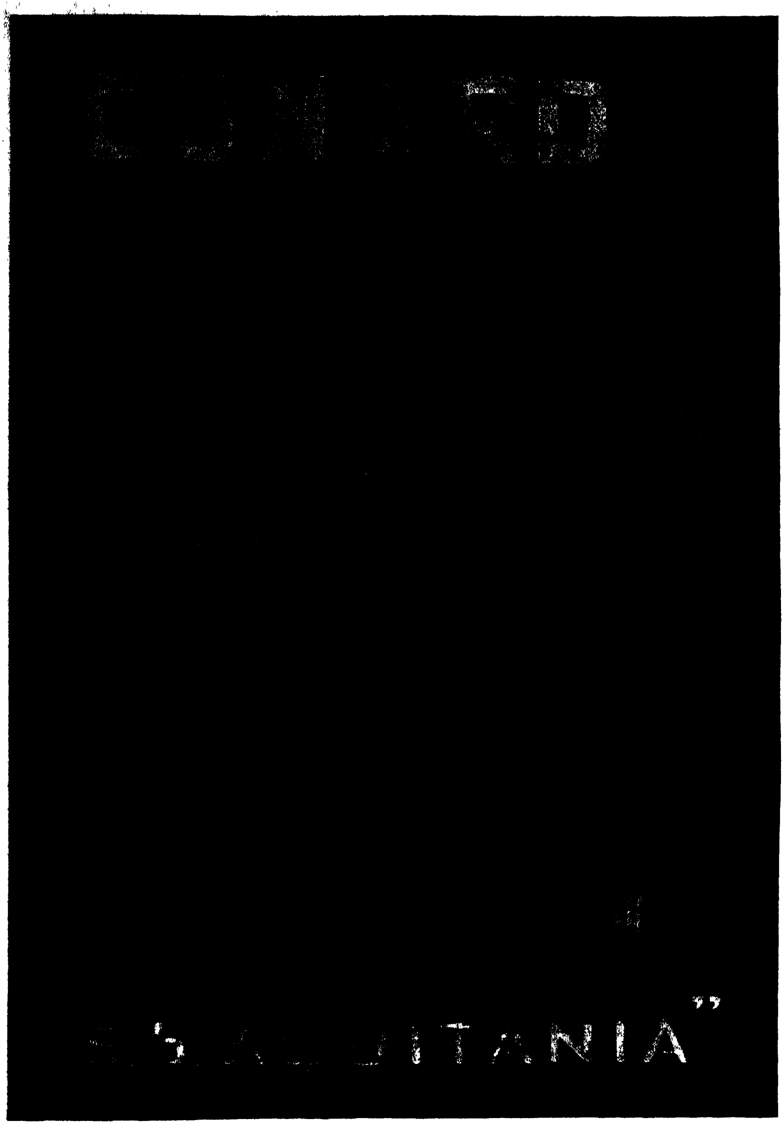
SAFETY BRAKE MECHANISM FOR ELEVATORS AND HOISTING CAGES.—J. C[illegible]ANI, 2217 Leatherwood St., Butte, Mont. In this invention the object is to provide a simple and inexpensive apparatus which may be actuated by a passenger or other person on the cage, in case of an accident such as the breaking of a rope, engine running away, a wrecked shaft; and other causes, permitting the passenger or other occupant of the cage to quickly and effectively check the lock and cage against movement.



SAFETY BRAKE MECHANISM FOR ELEVATORS AND HOISTING CAGES.

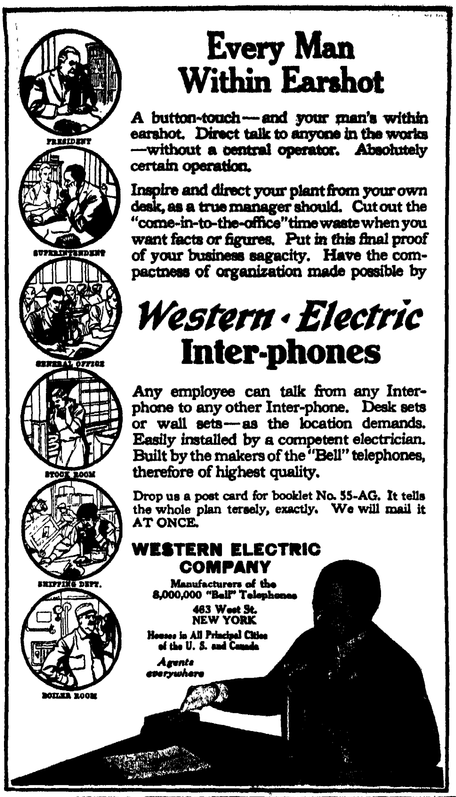
SUBMARINE MINE.—GIOVANNI E. [illegible], Rome, Italy. This invention relates to an ad-

(Continued on page [illegible].)



The first modern trans-Atlantic steamship, the "Britannia," was built in 1840 by the Cunard Steamship Company. She was unsurpassed in *her* day.
The latest modern trans-Atlantic steamer is the "Aquitania" of the Cunard Steamship Company. She is unsurpassed in *our* day.
Seventy-five years of Cunard experience in attaining supreme stability, speed and comfort are embodied in the "Aquitania."

Sailing from New York, June 10th, July 1st, July 22nd, August 26th



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A button-touch—and your man's within earshot. Direct talk to anyone in the works—without a central operator. Absolutely certain operation.

Inspire and direct your plant from your own desk, as a true manager should. Cut out the "come-in-to-the-office" time waste when you want facts or figures. Put in this final proof of your business sagacity. Have the compactness of organization made possible by

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Any employee can talk from any Inter-phone to any other Inter-phone. Desk sets or wall sets—as the location demands. Easily installed by a competent electrician. Built by the makers of the "Bell" telephones, therefore of highest quality.

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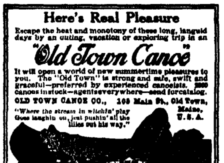
NEW YORK
Houses in All Principal Cities of the U. S. and Canada
Agents everywhere



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Goes laughin on, just pushin' all the
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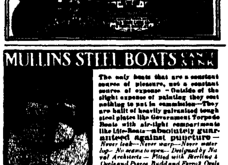

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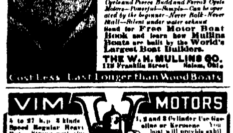

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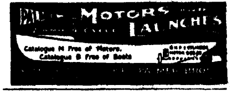

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Long Stroke 4 Horse Power

Fits any boat. Ball-bearing engine. 10½ inch Weedless Propeller 3-ring Piston, same as in Packard car Copper Water Jacket, same as Cadillac car Kingston Carburetor, same as in highest grade auto and marine engines. Silent Underwater Exhaust, same as in highest priced launches. Steers from any part of the boat. Perfect control from trolling to racing Sends 18 foot boat 8 to 9 miles per hour. Uses gasoline and oil mixed. No vibrations. No noise. Runs and keeps on running day after day Guaranteed for life. Money back without argument if not satisfied. Write for free catalog and special 30-day price.

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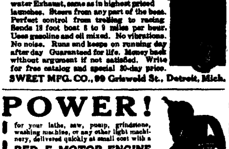

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Notes for Inventors

A Novel Target.—In a patent No. 1,092,425 Frederick Bohn of Kiel, Germany, describes a target for marine aiming drill. The target simulates the movement of a rolling ship, being for such purpose given a movement, with alternate velocity, up and down and laterally.

Improved Refrigerating Apparatus.—Adolphe E. Bossé of Pittsburgh, Pa., has secured patent No. 1,092,426 for a refrigerating apparatus by which to prevent the improper operation of the apparatus and thus avoid accumulations of high pressure of the gas.

Typewriter Eraser Operated by a Key.—In patent No. 1,083,466 Harry I. Seddon of Portland, Ore., provides an erasing means for a typewriter in which an erasing head is yieldingly pivoted on a bar and the latter is connected to a key lever so that the key lever may be moved to operate the eraser.

French Artificial Wood.—Information has been made public in Lyons, France, concerning an artificial wood, which, it is stated, will be of great value as a substitute for natural wood. The new product has been found after years of study and practical experiments, the most recent of which have given eminently satisfactory results. The process consists in transforming straw into a solid material having the resistance of oak. The straw after being cut into small pieces is reduced to a paste by boiling, to which certain chemicals are added. When the paste has been reduced to a homogeneous mass it is put into presses, and planks, beams, laths, and moldings of all sizes are readily made. This new material can be sawed like natural wood. As a fuel, it emits a bright flame and little smoke. It is further stated to be adaptable to the manufacture of match stems.

An Automatic Gas Extinguisher.—Edwin H. Hawley of Washington, D. C., in patent No. 1,088,987 shows an automatic gas extinguisher in which a self-closing stopcock is released by a trigger arranged adjacent to a flexible diaphragm carried by an annual air chamber made of thin sheet metal and located above the burner, the trigger being adapted to release the self-closing stopcock.

A Dose-indicating Glass Cover.—Ithamar P. Berthrong of Washington, D. C., has secured patent No. 1,091,114 for a dose indicator. A glass cover has a central depression to receive a spoon bowl. An upstanding rim flange is notched to receive the spoon handle and is provided with dial fingers corresponding with the notches, so that the location of the spoon may indicate the time when the next dose should be taken.

An Illuminated Practice Target.—In patent No. 1,091,116 to William H. Buel of New Haven, assignor to Winchester Repeating Arms Company, is shown a target whose impacted surface is prepared with a flash-light composition ignited by the impact of a bullet so that a circumscribed area about the point of strike is illuminated, and can be seen by the marksman.

Sterilizing Liquid by Means of Ultra-Violet Rays.—Patent No. 1,091,221 to the R. U. V. Company, Inc., of New York, presents an apparatus for sterilizing liquid in which a vapor electric lamp is immersed in the liquid in a tank and an envelope permeable to ultra-violet rays surrounds the part of the lamp which emits ultra-violet rays, air being exhausted from the intermediate space.

Printing Signs on the Pavement.—William J. Ryan of Sapulpa, Okla., in patent No. 1,092,749 provides means for stamping a sign or advertisement on a street pavement rapidly and at successive intervals.

Helping the Eye to Follow a Golf Ball.—William Hiram Brown of Cleveland, Ohio, in patent No. 1,091,186 provides a device designed to aid in teaching a golf player how to make a stroke, it being based on the idea that a golf player shall "keep his eye on the ball."

A Novel Air Brake System.—Frank H. Dukesmith of Meadville, Pa., assignor to Thomas C. Vanhorne, Pittsburgh, Pa.,

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PATENTS
Trade Marks Designs Copyrights &c.

INVENTORS are invited to communicate with Munn & Co., 361 Broadway, New York, or 625 F Street, Washington, D. C., in regard to securing valid patent protection for their Inventions. Trade-Marks and Copyrights registered. Design Patents and Foreign Patents secured.

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FORD OWNERS. Wall's Ford Valve Cleaner will clean carbon from valve seats without removing cylinder heads. Automatic rotating motion. Easy to operate. $2.00 delivered. Send for circular. J. [illegible] Wall, Bristol, R. I.

INQUIRIES

Inquiry No. 9364. Wanted the name and address of buyer of mica in a crude state.

Inquiry No. 9365. Wanted the name and address of a manufacturer of machinery for embossing the foil as is used in packing cigarettes.

Inquiry No. 9366. Wanted the name and address of a manufacturer of wire wheels, front axles complete with steering or separate, light sheet metal bodies, fuel tanks with cocks, pressed steel frames, mufflers, motors of the two cylinder opposed type, cushions and many smaller parts for cycle cars.

Inquiry No. 9367. Wanted the name and address of a manufacturer of an automatic centering machine.

Inquiry No. 9368. Wanted, the name and address of glass-bottle manufacturers or glass blowers who can manufacture a glass bottle and perforate it with some 12 small holes, in large quantities for export, to sell at a popular price.

Inquiry No. 9369. Wanted, the names and addresses of users of Indian Steatite (Soapstone), Corundum and other Indian minerals, in quantities.

Inquiry No. 9370. Wanted the names and addresses of manufacturers of small wooden articles, particularly in such soft woods as pine and fir, for articles such as toys, furniture, etc.

Inquiry No. 9371. Information wanted where one could buy or have made to order machine to be used for making solid back brushes.

Inquiry No. 9372. Wanted the name and address of manufacturers of a collapsible box about 12 inches square. It must be strongly made to withstand rough usage in transit.

LEARN WATCHMAKING and become independent. [illegible] Good-Paying Positions Secured. [illegible] ways in demand. Easy to learn [illegible] while studying. Write for [illegible] St. Louis Watchmaking School, [illegible]

[illegible] for an air [illegible] for holding [illegible] the train [illegible] pulling the train [illegible]. The engine brake is also held while [illegible] the train auxiliary [illegible], and the engine brakes are set without setting the train brakes.

Economical Firing of Locomotives.—George C. Weston of St. Louis, Mo., in patent No. 1,092,466 records the number of times the locomotive fire door is opened and aims thereby to induce the fireman to fire in a more economical manner by keeping the fire door closed as much as possible.

Safeguarding the Operator of Power Presses.—Milton E. Winans of Newark, N. J., assignor to Western Electric Company of New York city, in patent No. 1,092,667 guards against injury to the operator of a power press. When the treadle or supporting device is inadvertently held or depressed in abnormal position the machine cannot repeat its operation or stroke to the injury of the operator.

Folding the Gas Stove Into a Wall Recess.—Patent No. 1,092,681 to Raymond Stuart Way of Los Angeles, Cal., assignor of one half to Charles W. Prestley of same place, by a novel construction permits the folding of a gas stove out of the way into a recess in the wall when not in use.

Paper Feeding Apparatus.—In patent No. 1,092,437 Milford B. Ferguson of New York city, assignor to Package Machinery Company of Massachusetts, shows a paper feeding apparatus especially designed to feed single sheets from a stack in such manner as to overcome the liability of the apparatus to feed two or three sheets instead of one.

Increasing the Efficiency of Hydrocarbons.—A process which seeks to increase the heating efficiency, illuminating efficiency and explosive power of hydrocarbons, such as gasoline and naphtha, by the addition of specified materials of low cost is described in patent No. 1,092,461 to Arthur W. Swanberg of Minneapolis, Minn.

Encourages Railway Invention.—U. S. Consul Treadwell of Bristol, England, writes in an interesting way of an undertaking by the Great Western Railway to investigate and patent inventions which relate to mechanical contrivances likely to be useful on railways and suggested by any of the employees. This will doubtless operate as an encouragement to their force of men, but it does not in any way prevent such men from offering their inventions elsewhere. However, it provides for assistance to such men in case they do not find themselves in position to take out patents for railway inventions that may prove of great value. It is reported that other railway companies, appreciating the merits of the scheme, have similar projects under consideration.

A Series of Air Brake Patents.—Spencer G. Neal of Los Angeles, Cal., assignor to California Valve & Air Brake Company of the same place, has secured patents Nos. 1,089,574, 1,089,576, 1,089,577, 1,089,578 and 1,089,579 for improvements in compensating valves and patent No. 1,089,575 for an auxiliary pressure control valve, the several valves having the particular construction specifically described in the patents.

Inventors and Industrial Artists in Congress.—The Society of Inventors and Industrial Artists will hold its fourth international congress in Lyon, France, August 17th to 21st of this year. Among the matters which will be discussed at the congress are (1) International patents; (2) The exploitation of patents; (3) Proper means to encourage inventors; (4) Course and duration of patents; and (5) International deposit of designs and models.

Combining a Steam Boiler with the Oil Burner.—In patent No. 1,089,076 granted to [illegible] Flack of Kansas City, Mo., is shown a steam boiler with an auxiliary [illegible] removably mounted in the [illegible] of the boiler and an oil burner [illegible] to the boiler and [illegible] the auxiliary generator.

Trade-mark Notes

Hosiery and Knit Underwear Same Description of Goods.—In a recent decision Court of Appeals of the District of Columbia in the case of H. Wolf & Sons, appellants, v. Lord & Taylor, appellee, sustained the decision of the Commissioner of Patents supporting the opposition by Lord & Taylor to the registration by H. Wolf & Sons of the same mark for use on knitted and textile undershirts, drawers and union suits of the mark of Lord & Taylor registered for hosiery. In the decision the court said, "Would appellant's use of the mark on underwear lead the ordinary purchaser to believe that he was buying the goods of appellee? We think the word "class," as used in the statute, means broadly a genus, including as species any goods upon which the use of the same mark when on the goods exposed side by side would tend to mislead the purchasing public."

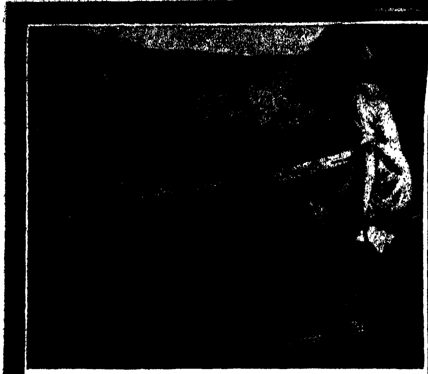
Value of Trade-marks in Central America.—Commercial Agent Garrard Harris, in an interesting communication calls attention to the fact that it is not generally known nor appreciated as it should be by American exporters that trade-marks play a very important part in lower Mexico and Central America, in fact, a leading part in the sale of foreign manufactures, and appears to think that trade-marks have a greater significance in such countries than in the United States. He says it is not difficult to ascertain the value of these trade-marks and trade names in the countries named, as any storekeeper can give the information, and an investigator can obtain abundant information for himself by spending several hours in a store listening to the inquiries of customers who invariably ask for an article by the trade name or the trade-mark by which it is generally known; and if the trade-mark is something they can see and describe, like a star, a crescent, the sun, or a pine tree or any such object, so much the better.

Trade-mark Showing How Goods are Used.—The Court of Appeals of the District of Columbia in affirming the decision of the Commissioner of Patents refusing registration of an alleged trade-mark for "non-metallic electric vehicle tires" in re the Motz Tire and Rubber Company, said: "Moreover, we agree with the Commissioner that the representation of a rim for a tire with a tire thereon, even though the tire be disclaimed, is not registrable as a trade-mark, for the reason that no manufacturer should be prevented from representing to the public the manner in which his goods are used."

Acquirement of Trade-mark Rights.—The Court of Appelas of the District of Columbia in Consumers Company v. Hydrox Chemical Company says, "It is settled law, in this court, that a trade-mark is not acquired by the invention or the discovery of a word or symbol, or by advertising. It only becomes a trade-mark by attaching or affixing it to certain articles of merchandise."

Trade-marks as Applied to Publications Distributed Free.—In *ex parte* The Curtis Publishing Company Assistant Commissioner Newton, in holding the mark patentable, decided that a publication which is distributed free for advertising purposes constitutes merchandise within the meaning of the trade-mark Act and a mark used on such publications is registerable, saying in his decision "They do not pretend to publish this magazine gratuitously, and it is thought that the office should be liberal rather than restricted in its interpretation of what publications are held as merchandise under the trade-mark statute."

The Trade-marks "Grandmas" and "Mothers."—The Court of Appeals of the District of Columbia in affirming the decision of the Commissioner of Patents in Bromund Co. v. Columbia Wax Products Co., *holding that* appellee is entitled to the registration of the word "grandmas" over the prior adoption and use of the word "mothers," in which the Commissioner said the words neither looked alike nor sounded alike, the court said in cases of this kind the evidence of the eyes is more persuasive and satisfactory than any other.



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The motor weighs about fifty pounds and may be carried about like a satchel. It possesses features that no other marine motor can have, because its features are exclusive ones. There are no batteries to carry about because the "Evinrude" is equipped with a

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This magneto is not affected by rain, waves or even complete submersion. It has only one moving part and starts the motor with a one-twelfth revolution of the fly-wheel. The motor is constructed in the same manner as the finest automobile engine made and has won so many prizes for economy and endurance that twelve governments, including the United States, have officially adopted it. **It is built by the largest manufacturers of row-boat motors** in the world, and their **capacity is 60,000 "Evinrudes"** per year. Every motor is absolutely *guaranteed.* Making a motor-boat of any rowboat has enabled thousands upon thousands of people to enjoy the pleasures of motor-boating at a minimum expense. "Evinrudes" are on sale at Hardware and Sporting Goods Dealers throughout the United States.

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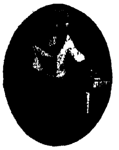

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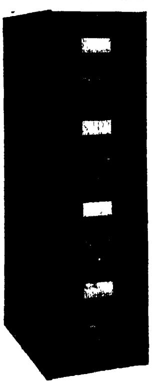

The Problem of the Hudson River

(Concluded from page 357.)

driven by its own propellers, except within a comparatively narrow belt immediately in the vicinity of the stern.

Changing conditions due to varying widths of channelway were determined by means of vertical walls placed upon the false bottom and held in place by means of bags of sand. Three different widths were examined, i. e., 2,000 feet, 2,400 feet, and the present existing one of 2,800 feet. The moving pictures taken were projected by means of a proper apparatus and upon a scale which permitted them to be studied deliberately and easily. From these data curves were plotted which gave exceedingly instructive information to the experts, and which clearly indicated the extent of the forces and their probable effect.

It would be technically interesting to go into details, but that is not possible here. The net result of the tests showed that a large liner advancing at any speed permitting her navigation against the tide caused lateral disturbances on either side of her extending for a distance of quite 400 feet, i. e., a total danger zone of 800 feet. With increase of speed the force of these perturbations and their menace were augmented proportionately. For vessels moored between piers the effect upon them of passing craft of large size was found to be more serious when the wharves were resting upon open piling than when extending solidly down to the river bed. This revelation had to do particularly with the temporary extension allowed in the case of one of the Chelsea piers for the sheltering of the stern of the "Olympic."

Because of these investigations, the army engineers of the Harbor Line Board emphatically concluded that "the fairway of the Hudson River should not be further decreased, especially in the vicinity of the Chelsea reach." Thus for an outlay of a few thousand dollars data full of warning have been obtained, which may save us from serious mistakes and result, besides, in reducing the dangers to river traffic, and probably mean an economy of many millions of dollars in fuel costs that would certainly have to be borne were the channelway narrowed and tidal velocities augmented.

Dr. Hertoghe on Thyroid Deficiency

AMONG the guests of honor at a dinner given by Dr. William Seaman Bainbridge of the New York Polyclinic Hospital during the recent International Congress of Surgery were many prominent members of the profession, both of this continent and of Europe. The list included Prof. E. Hertoghe of Antwerp; Dr. A. C. Jordan of Guy's Hospital and of the Royal Free Hospital for Chest Diseases, London, England; Dr. Merrill Ricketts of Cincinnati, noted for his researches in intrathoracic surgery; President J. A. Wyeth of the New York Polyclinic Hospital; Prof. Laplace; Dr. Jackson of Philadelphia; Dr. Bruce of Toronto; Dr. Armstrong of Montreal; Dr. Sajous of Philadelphia; Dr. Tinker of Ithaca, N. Y.; and many others.

Prof. Hertoghe, in his after-dinner remarks, gave a most interesting account of his pioneer work in the treatment of conditions due to disorders of the thyroid gland (the gland in the neck, the enlargement of which produces the condition known as goiter). While extreme deficiency of this gland produces unmistakable symptoms, such as dwarfed growth, abnormally low temperature, puffing up of the face, low mental powers (idiocy), in milder cases the symptoms are much less obviously referable to thyroid deficiency, but that this is their true cause is proved by the fact that they yield perfectly to administration of thyroid extract. A number of obscure cases that had baffled physicians were thus made the subjects of spectacular cures. Dr. Jordan showed a number of slides illustrating the use of Röntgen rays for thoracic and abdominal diagnosis, and especially for the diagnosis of "intestinal stasis"—a subject discussed in these pages three weeks ago. Dr. Ricketts illustrated modern advances in surgery on the

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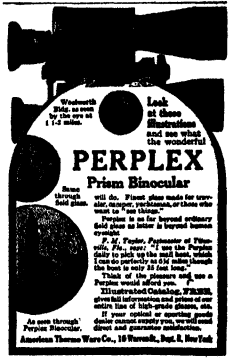

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brain and heart, organs which until lately generally were thought almost too vulnerable to permit of operative intervention.

John Henry Poynting

THE world of physics mourns the death of John Henry Poynting, who passed away on March 30th, at his home in Birmingham, England.

Of Poynting's scientific researches no doubt the most important are his contributions to the theory of the electro-magnetic field. In two memoirs, "On the Transfer of Energy in the Electro-magnetic Field" and "On the Connection Between Electric Current and Electric and Magnetic Inductions in the Surrounding Field," he has shown that the flow of energy in such a field takes place in a direction perpendicular both to the lines of electric and also of magnetic force, and can thus be represented in direction and magnitude by a certain vector, which has become known as *Poynting's vector*. The wire "carrying an electric current" is seen to be merely a guide for the electrical energy flow—the flow itself takes place along lines which permeate the entire space about the conductor, and abut perpendicularly against the wire. The energy, so far from "flowing along" the wire, is propagated sideways into it from the surrounding space.

During the later years of his life Poynting devoted much of his attention to the subject of radiation pressure, to which he made important contributions both in its theory and in experiment. He demonstrated the tangential pressure of light, and showed that a beam of light behaves essentially like a stream of momentum. He showed that radiation pressure, though small, plays an important *rôle* in cosmic phenomena. Turning to other aspects of the subject of radiation, he indicated means for determining the temperature of celestial bodies and interstellar space. Of his earlier work the chief was his determination of the general constant of gravitation by means of an ordinary precision balance with an adjustable mass placed under one of the pans. In this way the effect of the adjustable mass was compared with that of the earth itself, so that one is justified in describing the experiment as "weighing the earth."

Poynting was the author of numerous other scientific papers, and the joint author with Sir J. J. Thomson of a series of textbooks of physics. He also published several books of a more popular character.

Poynting was connected with Birmingham University (then Mason College) since its birth, in 1880, and on the coming of age of the institution, in 1901, he was appointed dean of the faculty of science. This office he held until recently, when ill health forced him to restrict his work to his professorial duties.

As a teacher Poynting will be remembered by his pupils as a man possessing in a singular measure the faculty of stirring interest and training the mind to rigorous thinking. Just what such influence means only those know who have actually experienced it.

The principal honors that came to Poynting in the course of his career may briefly be sketched here. At the mathematical tripos he was bracketed third wrangler in 1876, and later gained the Fellowship of Trinity College, Cambridge. In 1888 he was elected Fellow of the Royal Society, whose gold medal was awarded to him in 1905. In 1891 he received the Adams prize, and in 1899 he was made president of section A of the British Association. The meeting of that year is memorable for the announcement, by J. J. Thomson, of the separate existence of electrons. In 1905 Poynting was chosen president of the Physical Society.

We have spoken of Poynting as the investigator and the teacher. Those who knew him as a man need not to be reminded on this occasion of the qualities which endeared him to those so privileged. That modesty and freedom from all hauteur which is the surest sign of a truly great mind, was among the most marked traits of his character. A balance of mind which is not always found in those who [illegible] prominence in special fields rendered invaluable his opinions and judgments in matters of weight. His heart was as great as his mind. A. J. L.

Air Craft on the Defensive and Offensive

A Review of Recent Experiments

FRANCE is zealously striving to adapt the flying machine to aggressive warfare. Among others, there were begun at the flying field at Buc in October, 1913, tests before a military committee with the so-called "Air Craft Hunter" of Lieut. Mailfert. The flying machine, which was already exhibited at the last Aeronautic Exhibition in Paris, is a Nieuport monoplane of 160 horse-power. It contains in its *fuselage* a shot-sieve or a projectile thrower, an arrangement which, when the pilot sets it in action, strews the underlying ground with two thousand shot. An aiming arrangement is said to be at hand. On the flying field a flying machine was represented to actual scale by means of a disk. Lieut. Mailfert rose in his machine to a height of 2,000 meters and flooded the target with his projectiles. The disk was riddled with many bullets. Then free balloons were released, against which also Mailfert brought his shot sprinkler into action. He succeeded in causing two balloons to sink.

Another kind of aggressive flying machine, the so-called "Zeppelin-Hunter," was put to trial last summer, according to the Paris *Journal*. With its own weight reduced to a minimum, it had to carry an armor of 60 to 70 kilogrammes to protect both the pilot and the more vulnerable parts of the machine. *It is* intended to provide the flying machine with a light machine gun, which can perforate the Zeppelin hulls with rapid fire shot and ignite the gas.

In January, 1914, an experiment took place also in Villacoublay, with a new armored flying machine, which was built and provided with a rapid-fire gun, according to the directions of the heads of military aeronautics. The ordnance, presumably a machine gun, is claimed to have signal striking capacity. The flight, however, which the pilot, Espaner, effected with the new aeroplane, was not very fortunate.

The French papers emphasise that in future all French military air craft, except the school machines, will be armored to protect them against hostile fire. They may be divided into the following kinds:

1. Armored monoplane for reconnoitering artillery and cavalry. Minimum velocity, 120 kilometers per hour.
2. Armored biplane for reconnoissance work of the general staff at great distances. Minimum velocity, 100 kilometers per hour.
3. Armored biplane which, provided with machine guns, etc., shall destroy hostile aeroplanes and airships. Minimum velocity, 120 kilometers per hour.
4. Large aeroplanes with more seats, for special service.

The Paris Aeronautic Exhibition last fall showed a special number of armored aeroplanes. The armor protection extended not only to the pilot and observer, but also to the provisions, the rudders, the measuring instruments and especially the propulsion system. The aeroplanes not intended for aggressive warfare were for the most part provided with wireless apparatus.

The improvement in the possibility of observation was shown at Villacoublay late in November, 1913, on a new kind of aeroplane in which the seat for the observer is placed forward, directly under the screw propeller. Deputy Girod, piloted by Gobé, flew over the field several times and made effective observations. The capacity for observations from this position is without doubt greater, still the observer in this advanced position is more exposed to hostile fire, and above all is incapable of taking charge of the controls of the aeroplane in case of failure of the pilot.

At Farnborough in England last year a trial of sharp-shooting from aeroplanes was held. A military biplane was provided with a machine gun and ammunition; this gave, from an elevation of 120

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MODEL OF	1910		1911		1912		1913		1914	
CARS	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Abbott Detroit	A	Arc.	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
Alco	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.		
American	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Autocar (2 cyl.)	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" (4 cyl.)	A	E	A	Arc.	A	Arc.				
Avery	A	E	A	E	A	A	A	A	A	A
" (Model C)									Arc.	Arc.
Buick (2 cyl.)	A	A	A	A	A	A	A	A		
" (4 cyl.)	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" (6 cyl.)									A	Arc.
Cadillac	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Cartercar	A	E	A	E	A	E	A	E	Arc.	Arc.
" Com'l	A	E	A	Arc.	A	Arc.	A	Arc.		
Case			A	A	A	Arc.	A	Arc.	A	Arc.
Chalmers	Arc.	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.	A	A
Chase (air)	B	B	B	B	B	B	B	B	B	B
" (water)									Arc.	Arc.
Cole	Arc.	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Delaunay Belleville	B	A	B	A	B	A	B	A	B	A
E M F	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.				
Empire	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
Fiat	A	A	B	A	A	A	B	A	B	A
Flanders	E	E	E	E	Arc.	Arc.				
" (6 cyl.)							Arc.	Arc.		
Ford	A	Arc.	E	E	E	E	E	E	E	E
Franklin	B	Arc.	A	Arc.	A	Arc.	A	Arc.	A	A
" Com'l	B	A	B	A	A	Arc.	A	Arc.		
G M C Truck					Arc.	Arc.	A	Arc.	A	Arc.
Havers			A	Arc.	A	Arc.	A	Arc.	A	A
" (Model 6-60)									Arc.	Arc.
Haynes	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Hudson	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Hupmobile (Model 20)	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.		
(Model 32)							A	Arc.	A	Arc.
I H C (air)							B	A	B	A
" (water)							A	A	A	A
International	B	A	B	B	B	A				
Interstate	A	E	A	Arc.	A	Arc.	A	Arc.		
Jackson (2 cyl.)	A	A								
" (4 cyl.)	A	Arc.	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
" (6 cyl.)									Arc.	Arc.
Jeffery									A	A
" Com'l					Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Kelly			Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	A
King			A	E	A	E	A	E	A	A
" Com'l									Arc.	Arc.
Kissel Kar	A	E	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
" " Com'l			Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" " (Model 48)									A	A
Kline Kar	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
Knox	B	A	B	A	B	A	B	A	B	A
Krit	A	A	A	A	A	A	A	A	A	A
Locomobile	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	E	E
Lozier	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
Mack	A	E	A	E	E	E	E	E	A	E
" (Model [illegible])							A	A	A	A
Marion	A	E	A	E	A	Arc.	A	Arc.	Arc.	Arc.
Marmon	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Maxwell (2 cyl.)	E	B	E	E	D	E				
" (4 cyl.)	E	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" (6 cyl.)							Arc.	Arc.	Arc.	Arc.
Mercer	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Mitchell	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Moline	A	E	A	Arc.	A	Arc.	A	Arc.		
Moline Knight									A	A
Moon (4 cyl.)	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
" (6 cyl.)									Arc.	Arc.
National	A	A	A	A	A	A	A	A	A	A
Oakland	A	E	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
Oldsmobile	A	E	A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
Overland	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Packard	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
Paige Detroit	E	E	A	Arc.	A	B	A	E	A	A
Pathfinder							A	Arc.	Arc.	Arc.
Peerless	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Pierce Arrow	Arc.	Arc.	A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
" " Com'l			Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Pope Hartford	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Premier	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Rambler	A	A	A	Arc.	Arc.	Arc.	Arc.	Arc.		
Regal	A	E	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Renault	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Reo	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Saxon									E	E
S G V			B	Arc.	B	Arc.	B	Arc.	A	Arc.
Selden	A	E	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Simplex	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Speedwell	Arc.	Arc.	A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
" Mead							A	Arc.	B	A
Stearns	Arc.	Arc.	A	Arc.	A	Arc.				
" Knight					A	A	A	A	B	A
Stevens Duryea	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Stoddard-Dayton	Arc.	Arc.	A	A	A	A	A	A		
" " Knight					A	A	A	A		
Studebaker	E	E	A	Arc.	Arc.	Arc.	A	Arc.	A	Arc.
Stutz					Arc.	Arc.	Arc.	Arc.	A	A
Velie (4 cyl.)	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" (6 cyl.)									Arc.	Arc.
Walter	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
White	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Winton	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.

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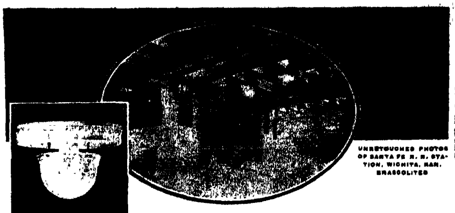

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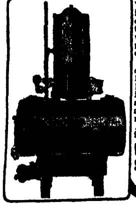

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meters, 20 shots directly downward. As to its striking capacity and effect, nothing has been reported; the recoil from the shot was without notable influence on the equipoise of the aeroplane.

Also a Birmingham society instituted at Bisley sharp-shooting at an aeroplane with a machine-gun. The 25-pound, air-cooled machine-gun invented by Col. Lewis was fixed on a tripod on the aeroplane framing; on a tripod was also placed the movable seat for the protection of the aviator. Out of thirty shots at a target space of 20 feet, 11 hits were scored. From what elevation the aeroplane fired has, however, not been reported, nor the velocity of the air craft, nor the kind of target arrangement.

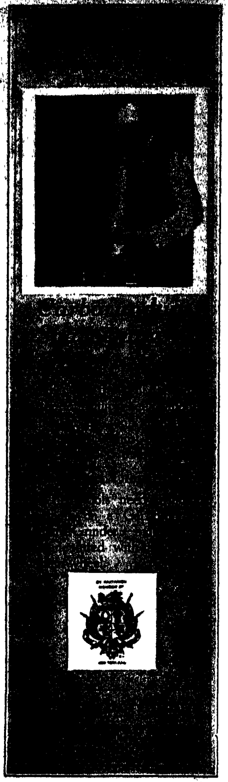
A sighting arrangement for machine guns on air craft has lately been patented. The machine gun is fixed between the legs of the observer sitting forward and having charge of the gun. The aviator sits elevated behind the observer. The fore part of the aeroplane is covered with a hood which carries on top a notch and sight. When the target is in sight the observer calls to the pilot and adjusts the sighting arrangement for distance and altitude. The aviator directs the aeroplane at the target by use of the rudders in conjunction with the notch and sight. When the observer perceives that the direction coincides he promptly fires.

An aeroplane projectile with rear rudder has been made in England. A tube extends lengthwise through the middle of the cylindrical projectile, filled with explosive. It carries, in front, trigger pins and percussion caps separated by an interspace, and having well to the rear an ignition charge. Both parts are secured by bolts fixed to the aeroplane frame, and, through the projectile, interlock in the tube, and so protect the aeroplane from destruction by its own discharge due to hard landing, shocks, etc. The part of the tube extending to the rear of the projectile carries the tail rudder. The projectiles hang on two hooks perpendicular to the floor of the aeroplane frame. When the projectile is to be thrown, the aviator establishes a special relation between the measured altitude and the velocity of flight, aims at the target, and, by means of a hand lever, releases the supporting arrangement of the projectile. The projectile, now free, sets itself point downward by means of its tail rudder. Since the two safety bolts have remained behind in the aeroplane, the igniter is in working condition, and when the projectile strikes, the trigger pin pierces the percussion cap, ignites the ignition charge, and this sets off the explosive charge of the projectile.

Shooting at aeroplanes was carried on last year in the camp at Chalons. A kite seven meters in width by six meters in length, represented an aeroplane and was towed by an automobile and wire cable with a velocity of 60 kilometers per hour. It was fired at by two squads of infantry, of fifty men each, at a distance of 800 to 900 meters. Out of nine hundred shots (nine cartridges for each man) twelve hits were scored on the kite, that is 1.3 for each man. A second shooting, with the same number of men, at a small kite, measuring 1.5 meters broad by 1 meter long, gave 0.5 shot per man, but at a distance not reported. Machine guns were trained against the same target, but with less effect.

A Spanish aeroplane was hit last November by Maroccans. Capt. Barreiro and Lieut. Gil-Rios undertook, in a reconnoissance on a military biplane, to observe the position of the insurgents. In this they were subject to fire by a group of hostile troops which had got footing on Conical Mountain. The lieutenant was grievously injured by two shots, the captain was wounded by one shot. It was possible for the officers, in spite of their wounds, to fly back again to their own camp—a proof, therefore, that even effective fire does not always put an aeroplane out of commission, and that an energetic aviator, even in spite of his wounds, will often carry out his orders.

[Translated for the SCIENTIFIC AMERICAN from Kriegstechnische Zeitschrift.]



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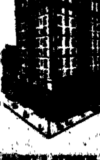

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Patents Which Expire in 1914

THE United States patents issued in 1897 for seventeen years will expire on corresponding dates in 1914. Among the important patents which will expire in 1914 are as follows:

In machines for cultivating a number of rows of crops is the patent to Davis, 576,059, January 26th, 1897; the swing or hammock cultivator patent to Sobey, 578,502, March 9th, 1897; the harrow patent to Sharp, 589,797, September 7th, 1897, and that to Ryder, 585,941, July 6th, 1897, which shows harrow teeth and supporting wheels at right angles on rocking tooth bars, so that as one device is thrown out of operation the other is thrown into operation; the check rowing, drilling and hand dropping planter patents to Lindgren, 577,487, February 23rd, 1897, and to Dooley, 593,295, November 9th, 1897; the Eltsroth patent, 579,049, March 16th, 1897, for a broadcast seeder in the form of an attachment that can be substituted for the end board of an ordinary farm wagon; the corn harvester patent to Ellis and Stewart, 577,105, of February 16th, 1897; the Sauer, 576,510, February 2nd, 1897, relating to the production of various kinds of wine from malt by the aid of properly selected grape ferments; the Swenson patent, 591,304, October 5th, 1897, for the volute type of cotton press; the Lowry patent, 581,601, April 27th, 1897, for a cotton press in which the cotton is fed under great pressure through a rotating head, also the Lowry cotton press patent, 581,600, of April 27th, 1897; the Hudson, 587,826, of August 10th, 1897, for a cigarette machine in which the ends of the paper are tucked around the tobacco as in certain handmade cigarettes; the Campbell, 579,422, of March 23rd, 1897, for making the well-known elliptical cigarettes; the cigar machine patent of Bunn, 579,859, of March 30th, 1897, in which the rollers are composed of short sections to adapt them to fit various forms of bunches; the Underwood patent, 591,436, of October 12th, 1897, for tobacco leaf stemmer in which the leaf is fed stem first between the stripping rolls until gripped by gripper rolls; the Fargo patent, 583,143, of May 25th, 1897, combining a churn and a butter worker; patent to Vidal, 594,105, November 23rd, 1897, for an artificial die made by heating synthetic substances with sulphur and sodium sulphide; the Tiemman's patents, 583,719 and 583,720, of June 1st, 1897, relating to improvements in synthetic perfumes, the patents being for aromatic ketones; the artificial camphor patent to Nagel, 582,221, of May 11th, 1897; the patent to Constam, 579,317, March 23rd, 1897, for a process of making percarbonates for bleaching purposes; the Carr patents, 583,565, of June 1st, 1897, and 581,335, April 27th, 1897, for dental bridge-work; the Wildprett patent, 577,866, of January 26th, 1897, for ladders for store service; the Knight patent, 587,442, of August 3rd, 1897, for a simple scheme for the transition of two or more electrical motors which may be connected in series, in parallel or in any relation of series and parallel; the Schimpf, 582,237, of May 11th, 1897, for the application of electricity to agriculture apparatus; the Cox patent, 585,257, of June 29th, 1897, for electric meter to give different readings in accordance with the rate of charges where different rates for electric service are charged; the hydraulic motor patent, 595,027, to Westinghouse of December 7th, 1897, in which a rotary pump connects with the two ends of the power cylinder and pumps the water from one end of the cylinder to the other to move the piston; the hydraulic press patents to Parfitt, 579,441, March 23rd, 1897, and to Winans, 582,836, of May 18th, 1897; the patent to Gulick, 579,265, March 3rd, 1897, for clamping means for the tubes of bicycles; the Forg patent, 581,907, of May 4th, 1897, for reducing weight in parts of bicycle constructions; the motorcycle patent, 583,809, of June 1st, 1897, to Libbey; the Streeter patent, 595,588, of December 14th, 1897; the Sargent patent, 587,408, of August 3rd, 1897, and the [illegible], 590,920, of [illegible], 1897, for brake-shoes for [illegible] [illegible]; the [illegible] patent, [illegible], of June 15th, 1897, for steel hopper-bottom cars; the Hardie patents, 577,024, of February 16th, 1897, and 580,827, of April 3rd, 1897, in which the car or locomotive reservoir in air storage motor cars is charged from a stationary plant; the electric motor-vehicle patents of Morris and Salom, March 30th, 1897, 579,890; Maxim patent, November 30th, 1897, 594,805; Woods patent, June 29th, 1897, 585,871; the patent to Morris & Salome, 578,651, of March 9th, 1897, in which separate motors for the driving wheels, for ease in turning motor vehicles, is shown; the patent to De Dion & Bouton, 593,877, November 16th, 1897, for a sparking igniter, and the patents to Westinghouse and Ruud, 583,584, 583,585, and 583,586, of June 1st, 1897, for charge feeding, speed regulating and igniting mechanisms for gasoline engines; the Maxim patents, 593,227 and 593,228, of November 9th, 1897, for automatic heavy ordnance; the patents to Browning, 580,923, April 20th, 1897; Ehbets, 580,935, of April 20th, 1897; to Manlicher, 581,295 and 581,296, of April 27th, 1897; to Mauser, 584,479, June 15th, 1897, and to Burgess, 589,120, of August 31st, 1897, for fire-arms (small arms); the Gathmann patent, 583,042, of May 25th, 1897, for projectile in which the explosion of the detonator is rendered harmless, being contained in a relatively large chamber and separated from the bursting charge by a movable metal barrier; the Schlick patent 594,288, November 23rd, 1897, for compound marine engine; the Symington patent, 581,789, of May 4th, 1897, for preventing compression in locomotive cylinders when drifting; the Curtis steam turbine patent, 590,210, of September 21st, 1897; the lubricator patent to Jones, 584,688, of June 15th, 1897, in which the feed of lubricant is automatically controlled by variations in the periods of its action; the Bowen patent, 583,668, of June 1st, 1897, showing an oil cup; the Porter and Hennessey, 587,272, of July 27th, 1897, for lubricator in which the oil is displaced by condensation of steam; the fuel briquetting patent to Batter, 580,568, of April 13th, 1897; the patents for acetylene machines in which carbide is fed to water as in patents, 575,281, to Buffington, January 12th, 1897; to Fuller, 575,474, January 19th, 1897; to Deuther, 567,955, February 9th, 1897; and to Rhind, 583,582, June 1st, 1897; Altenbaugh patent, 584,138, of June 8th, 1897, for a glass machine in which glass is gathered from a tank or furnace and delivered to a mold for making tumblers; the Hay patent, 582,587, May 11th, 1897, for an improvement in the utilization of the heat of cooling clinker of a cement kiln; the Garchey patent, 587,800, August 10th, 1897, for making imitation stone from waste glass; the Goldsmith patent, 578,868, of March 16th, 1897, for process of reducing refractory oxides; the patent to Abbott, July 27th, 1897, for machine for automatically forging horse-shoe nails; the patents to Locke, April 13th, 1897, 580,579, and to Viellard and Oswald, 580,564, April 13th, 1897, for automatic machines for cutting, bending and shaping links for drive chains from a continuous strip and assembling them into a chain; the gear cutting machine patents to Fellows, March 30th, 1897, 579,708, and to Warren, 588,738, of August 24th, 1897, in which the cutter bears to the blank being cut the relationship of an intermeshing gear; the incandescent gas mantel patent of Cortis, May 4th, 1897, 581,879, in which the life of the delicate mantel is prolonged by carrying the burner on springs; the Fuller patent, 580,126, April 6th, 1897, for burner designed to burn acetylene gas; the Cornell patent, 599,792, of March 30th, 1897, for machine for pasting labels on bottles, in which the label is sprayed with an adhesive and then spread upon the bottle; the patent, 583,072, May 25th, 1897, to Munson for making shucks for match boxes by refolding; the Noble patent, 586,054, July 6th, 1897, for machine for making paper tubes by forming continuous tubing by a spiral wind; the Potter patent, 574,498, January 5th, 1897, for printing press, including means for associating delivery and folding the product of the rotary press; the Harris & McNutt patent, 577,405, February

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16th, 1897, for rotary printing press, especially adapted for printing on cards and envelopes; the Wood patent, 589,519, September 7th, 1897, for means for preventing the off-set of fresh reprinted ink in printing presses; the typesetting machine patent to Ennisson & Honiss, 583,224, March 25th, 1897, which selects proper justifying spaces from a magazine; the type distributing machine patent to Cox, 578,216, March 2nd, 1897; the Dexter patent, 588,635, August 24th, 1897, in book-binding; the patent, 580,111, of April 6th, 1897, to Jacobs for machine for applying cloth book covers; the Johnson patent, 584,363, June 15th, 1897, for linotype machine improvement; the patent to Skursheedt et al., 591,079, October 5th, 1897, for mechanism for automatically feeding and stitching spangles to a foundation fabric; the patent to Reed, 580,531, April 13th, 1897, for a wood-turning machine for turning shoe lasts; the Fischer patent, 595,911, December 21st, 1897, for electrically operated clocks; the patent to Kellog, 591,169, October 5th, 1897, for automatically operating time-operated mechanisms; the patent to Brachhaussen, 596,393, December 28th, 1897, for automatic musical instrument; the musical instrument of Cahill, 580,035, April 6th, 1897, in which electrical vibrations corresponding to the notes of the musical scale are produced and combined by keyboards to correspond to chords collected on wire and transmitted to loud speaking telephones; the Olivary patent, 583,077, May 25th, 1897, for changing the pitch of larinates by partly filling the bore without affecting the finger holes; the patents in optics to Armat, 578,185, March 2nd, 1897, and Abbe, 584,976, June 22nd, 1897, the patent to Holport, 579,434, March 23rd, 1897, for boat lowering and detaching device adapted to release the boat on its being water borne; the Sinty patent, 581,625, April 27th, 1897, for reversing the angle of screw propeller blades for use with non-reversible engines; the Kaselowsky patent, 591,768, of October 12th, 1897 for automatic steering devices for boats adapted to operate on the principle of the gyroscope; the patent to Curtiss, December 28th, 1897, 596,294, for safes in which the dogging devices are held normally inoperative by thermostatic device released upon a rise of temperature; the all-glass show case patent of Ganter, 584,584, June 15th, 1897; the patent to Hale, 595,624, December 14th, 1897, for mechanism for reversing car seats, and the Johnson patent, 582,926, of May 18th, 1897, for artificial sponges for surgeons' use.

Napier Tercentenary Celebration, July, 1914

JOHN NAPIER'S *Logarithmorum Canonis Mirifici Descriptio* was published in 1614; and it is proposed to celebrate the tercentenary of this great event in the history of mathematics by a congress, to be held in Edinburgh on Friday, 24th July, 1914, and following days

The celebration is being held under the auspices of the Royal Society of Edinburgh, on whose invitation a general committee has been formed, representing the Royal Society of London, the Royal Astronomical Society, the Town Council of Edinburgh, the Faculty of Actuaries, the Royal Philosophical Society of Glasgow, the Universities of St. Andrews, Glasgow, Aberdeen, and Edinburgh, the University College of Dundee, and many other bodies and institutions of educational importance.

Through the SCIENTIFIC AMERICAN, the president and Council of the Royal Society of Edinburgh have now the honor of giving a general invitation to mathematicians and others interested in this coming celebration.

The celebration will be opened on the Friday with an inaugural address by the Rt. Hon. Lord Moulton, F.R.S., LL.D. (Edin.), etc., followed by a reception given by the Right Honorable the Lord Provost, magistrates and Council of the city of Edinburgh. On the Saturday and Monday the historical and present practice of computation and other developments closely connected with Napier's discoveries and inventions will be discussed.

A memorial service will be held in St. Giles's Cathedral on the Sunday.

Among many who have expressed a warm interest in the celebration and who hope to take part in the congress, may be mentioned Prof. Andoyer, Paris; Prof. J. Bauschinger, Strassburg; Prof. Hume Brown, Historiographer Royal for Scotland; Prof. F. Cajori, Colorado, U. S. A.; Prof. G. A. Gibson, Glasgow; Dr. J. W. L. Glaisher, Cambridge; Prof. Lang, St. Andrews; Prof. Macdonald, Aberdeen; Prof. E. Pascal, Naples; Prof. Karl Pearson, London; Prof. Eugene Smith, New York; Prof. Steggall, Dundee; Prof. Whittaker, Edinburgh.

Merchiston Castle, the residence of Napier, has long been occupied by the well-known public school, which draws pupils from all parts of the British Empire. The governors of the school have kindly invited the members of the congress to visit the castle and grounds on the Saturday afternoon.

Relics of Napier, collected by Lord Napier and Ettrick and other representatives of the family, will also be on view; and it is intended to bring together for exhibition books of tables and forms of calculating machines which may reasonably be regarded as natural developments of the great advance made by Napier.

Individuals, societies, universities, public libraries, etc., may become founder members on payment of a minimum subscription of £2; and each founder member will receive a copy of the memorial volume, which will contain addresses and papers read before the congress, and other material of historic and scientific value. It is important to secure as many founder members as possible, so that a volume may be brought out worthy of the memory of Napier.

Ordinary subscribers (5s.) attending the celebration may receive copies of the memorial volume at a reduced price.

Subscriptions and donations should be sent to the honorary treasurer, Mr. Adam Tait, Royal Bank of Scotland, St. Andrew Square, Edinburgh.

All who are interested in this proposed celebration are respectfully invited to communicate with the general secretary of the Royal Society of Edinburgh, 22 George Street, Edinburgh, and to announce their intention of being present.

Sound Perception v. Deafness

By Stanley Robinson

VERY few people are aware of the fact that totally deaf persons are really conscious of the noise they themselves make, or of the noise made by other persons or things, when such noises are made near enough to be communicated to their bodies.

The fact that the deaf, scientifically speaking, possess diaphragmatic hearing is known only to their friends and instructors. They hear, or rather feel, the concussion of many sounds almost as well as hearing people, through the vibrations on their ear diaphragms, these vibrations reaching the brain through the medium of the nerves of feeling.

I have not a particle of hearing myself, and write chiefly from my own experience, knowledge, and life-long association with the deaf. A totally deaf person is much like a man with his ears plugged up with cotton and thickly bandaged. Were the bodies of deaf mutes not sensitive to such sounds and noises as they feel or come in contact with, I fear they would be in a sphere of too great a silence. Noises make the deaf feel that they are not really deaf. Strange to say, sounds are often troublesome. The deaf often feel grateful that they can enjoy the benefit of so much silence as they do. Much of the time they are undisturbed by all the harsh sounds which agitate the ears of the hearing community.

Such sounds as are perceived or the sounds that come in constant contact with the persons of the deaf are often a help rather than a bother.

If you are told that the gentleman standing at your doorway is totally deaf, do not imagine that he can hear when you see him turn to look at a [illegible] truck. The noise of the truck on the cobblestones has simply been communicated to the man's body by vibrations. Had it been a rubber-tired vehicle drawn by a team of horses, the man would have been unconscious of its presence, because rubber-tired vehicles, as a matter of fact, produce no vibrations, and very little noise. The footsteps of the horses do not cause a sufficient noise for the man to feel, as they are too far away from him. The footsteps of a horse may be distinctly felt by a totally deaf person, provided he is near or within the required distance to feel the sound. The distinctness of the sound depends very much upon the kind of material on which the horse is walking. Thus if a horse is stamping on soft ground in order to remove an annoying fly, and the totally deaf man is but a few feet from him, the noise will appear to the man, for he will feel it as a dull thud. If, however, the horse is stamping or walking on a boarded surface, or platform, the deaf man will exclaim, "Oh, what a noise!"

Vehicles produce no vibrations when the streets are covered with snow or mud. Consequently, they are just as noiseless as rubber-tired vehicles. A deaf mute may pass throngs of people on the street, and yet not feel the sound of a single footstep. The only noise he will perceive will be the rumbling of some passing vehicle, also on an unpaved thoroughfare the sound of wagons or heavily laden trucks can scarcely be felt.

In many ways stone is a poor material for the conduction of noises to the body of a deaf mute. He will not feel the noise if you stamp on a stone pavement unless you are close to him.

A deaf mute will be conscious of all the noise in the room which he occupies He will feel the door slam, the fall of a ball, an apple, an orange, a key, or any other weight, the footsteps of persons in the room, if it is not carpeted, or if they do not have on rubber shoes or slippers; also the noise he makes with his own knife and fork when eating

Shortly after I became deaf, at the age of ten, I did not realize that my deafness was total, simply because through my sense of feeling I was still familiar with most sounds. But when I could not feel human voices, the fact was clearly established that I had not a particle of hearing left. A deaf man feels sounds better when they are near or when he has hold of hollow bodies, such as empty boxes, closets, iron or wooden pillars, which take sound vibrations better than solids Placing my hand on the panel of a closet door, I am able to feel faintly the thundering noise of a bass drum three hundred feet or more away. I can scarcely perceive such a deafening noise the same distance when standing against a wall of stone

Door Bells and Alarm Clocks.

A deaf person never feels the sound of a bell as its vibrations are confined solely to the atmosphere. I think there is no way by which the sound of such an instrument can be imparted to our feelings. On account of this draw-back every deaf mute who lives alone finds it necessary to arrange some kind of a device which will serve him either through his sense of vision or his feelings, as suitably as the ringing of the door bell serves any hearing person. Many of these devices, only a few of which I shall describe here, are very ingenious and novel as well as useful.

Deaf mute parents that have hearing children or hearing persons living with them, of course, need no substitute for their door bell. Families whose members are all deaf, or who have no hearing persons living with them, often have a dog whose barking and actions, when the bell rings, "hears" for them. Families that reside in houses that are no better than fire traps should always be ready to escape and save their lives in case of fire.

We do not always feel safe when asleep, because if a fire should occur we would not know it or would not be aroused in time by persons trying to save us by knocks and kicks at our door. Only a few months ago the school for the deaf at Malone, N. Y., was destroyed by fire, but as the pupils were well drilled to meet such an emergency, no one was injured.

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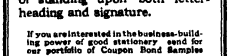

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Malleable iron and cast iron unions expand more **slowly** than wrought iron or steel pipe, when heat is applied Malleable iron unions **stretch** under the expanding pressure of the pipe, and because the elastic limit of the metal is low, they **stay** stretched and leak when pipe is cooled

Cast **brass** unions expand more **rapidly** than wrought pipe, and spread away from the pipe under heat, making such joints leak when hot.

Unions made of part malleable iron and part cast brass suffer **internal** trouble every time temperatures change, and leak **in themselves**.

The Mark Union is made wholly from wrought steel, with a soft **drawn brass** seat ring or gasket inserted in the female seat. When this brass gasket expands under heat, it tends to render the joint even tighter It is so soft, and the densified steel male seat that cushions into it is so exceedingly hard, that the Mark Union is proving its ability to hold unprecedented steam and hydraulic pressures under conditions in which every other form of union has failed.

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Such schools employ hearing night watchmen, as they are more suitable for such work.

Visiting a married mute couple in Brooklyn one day, I inquired how they could tell when their door bell rang so as to respond to it, they having neither dog nor children to hear for them. They showed me a hollow rubber ball suspended from the chandelier in their kitchen, where it could be seen from the parlor and the other rooms in the house. In an ingenious way the ball was attached to the hammer of the door-bell by means of a string, so that whenever the bell rang the hammer would jerk the string and cause the ball to oscillate for some length of time. The swaying of the ball told the busy housewife when someone was at the door. Many families have similar devices. While visiting this same family, the deaf man took me to the foot of his bed. There I found attached to the top bar of the bedstead an alarm clock. "This clock," said he, "awakens me every morning just when I want to get up. I feel the vibration of the alarm quite plainly, as it extends to all parts of the bed."

In the kitchen of another deaf couple living alone in New York city, I found that whenever their door bell rang, an American flag placed in an upright position in front of a window, would fall. When the occupant of the room saw that the flag was down, she or he would know what to do.

A deaf mute doing business in a New York city office has the door bell attached to the electric lamp over his desk in such a manner that the light goes out whenever there is a ring The sudden vanishing of the light causes the busy man to make a quick response.

Anthropological Exploration in Peru

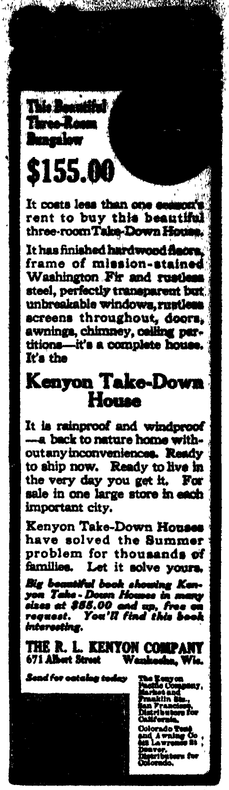
THE Smithsonian Institution has just issued a second report concerning the field work of Dr Ales Hrdlicka of the National Museum, carried on in Peru during the past year, in connection with the Panama-California Exposition at San Diego, for which a very important exhibit in physical anthropology is being prepared. The investigations extended over several hundred miles of the Peruvian coast and over hitherto unexplored regions in the western Cordilleras. The objects of this trip, which occupied the first four months of 1913, were to determine the relations of the ancient Peruvians of the mountains with those of the coast, and to extend the investigations which Dr. Hrdlicka has carried on for many years regarding Indian and especially pre-Columbian pathology dating back about 500 years.

The expedition was a very strenuous one, but proved remarkably successful. Over 100 ancient cemeteries and many ruins, a large percentage of which were previously unknown to science, were examined and over 30 boxes of skulls and other material for future study were collected for the United States National Museum and the Museum at San Diego.

The writer reports that skeletal material, which formerly abounded in Peru, and is essential to scientific research, is fast disappearing, and in a few years cannot be gathered without the expenditure of much time and money.

The results of the expedition will prove of unusual value to anthropology. While some of the links of the chain of evidence are still wanting, it can now be said with certainty that the Peruvian coast from Chiclayo, in the north, to Yauca, in the south—a distance of over 600 miles—was peopled predominantly before the advent of the whites by one and the same physical type of Indian. These Indians were of medium height, with short and broad skulls, and moderately to strongly developed muscles according to the locality. The most important fact ascertained in this connection was that both the Chimu and Nascas, two of the foremost cultural groups of ancient Peru, were identical, and as regards physical characteristics, inseparable parts of this coast people.

According to their location, the people of old Peru were either fishermen or farmers. They seem to have been organized in-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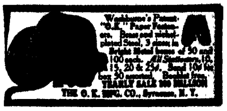
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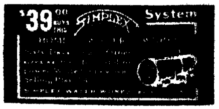
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[illegible]

to [illegible] which developed [illegible] greater cultural differences [illegible] environment and other influences.

Some of their smaller dwellings were made of wood, while larger structures were built of small uncut stones, sun-dried brick, or blocks of adobe. Their knowledge of weaving, pottery-making, and decoration was surprising. They wove from native cotton and llama wool, and their designs indicate the changes brought about by time and other influences. The native dress consisted principally of a poncho shirt, a loin cloth, and sandals, with simple head gear.

The pre-Columbian Peruvians of the coast knew the uses of gold, silver and copper, and worked these metals to some extent, especially copper in the manufacture of weapons. Their common weapons were a metal or stone mace, a wooden club, a copper ax and knife, the sling, and in some regions the bow and arrow. Their implements were the whorl, weaving sticks, looms, cactus-spine or bone needle holders, sharpened sticks, copper knives and axes, hoes, and fishing paraphernalia, including nets, sinkers, reed-bundle boats or balsas, and peculiar rafts which were paddled.

Throughout the whole territory along the coast the people deformed the heads of their infants by applying pressure to the forehead, probably by means of bandages and pads, which process flattened the back of the head as well. They did not practice filing, cutting, or chipping the teeth, or other mutilations which would leave marks on the skeletons.

It is interesting to know that these natives seem to have been comparatively free from general bodily ailments before the advent of the white men, although they suffered from several peculiar local diseases affecting the hip-bone, the head, and the ear. The people of the mountains possessed a good, average development of the body and of the skull, and were freer than the coast people from disease. It is evident that in some of the districts serious wounds of the head were frequently followed by the operation known as trepanning, and although this was often crudely done, it was successful in many cases. This practice was probably carried on even after the coming of the Spaniards.

The results of the expedition failed to strengthen the theories of the antiquity of man in Peru, but tended to prove the contrary. Aside from the cemeteries or burial caves of the common coast or mountain people, and their archeological remains, there was no sign of human occupation of these regions. Not a trace suggesting anything older than the well-represented pre-Columbian Indian was found anywhere; and neither the coast nor the mountain population, so far as studied, can be regarded as very ancient in the regions they inhabited. No signs indicated that any group occupied any of the sites for even as long as twenty centuries; nor does it seem that any of these people developed their culture, except in some particulars, in these places.

Dr. Hrdlicka's report is issued in the Smithsonian Miscellaneous Collections, publication 2246, and forms an exceedingly valuable addition to the anthropological works of Peru. It comprises 69 pages of text and 26 plates of illustration, showing specimens collected, locations of the finds and maps of the territory explored.

The Guns of Panama

(Concluded from page 383.)

mounted upon the Crozier type of disappearing carriage, are scarcely less deadly than their larger brothers, or sisters, for guns have been tacitly endowed with feminine appelatives. Although the 14-inch shells weigh but 1,660 pounds, their range is practically that of the sixteens, at extreme fighting range, and they are able to penetrate any armor now in use.

The main defense of a system of sea-coast fortification is found in the mortars. Costing less to manufacture, and projectiles and charges costing less, they are used in great numbers; and the effective range is slightly more than that of the rifles on the disappearing carriages. Fired at extremely high angles, their projectiles invariably plunge directly down upon the target, and though the velocity is comparatively low, no deck armor can withstand them.

The mortars are sunk in pits, in groups of two, each group manned by a company of coast artillery. They are seldom fired singly. As a rule a number of them are directed upon a target and fired simultaneously, a salvo, and in such a hail of steel, directed upon a common objective, at least one projectile, ship-disabling in its power, will most probably strike with deadly effect.

No definite information is given out by the War Department about the number of guns to be in the completed defenses of the Panama Canal, but at such an important point it is reasonable to suppose that it will be ample.

At a rough estimate there will probably be two or more of the 16-inch rifles, from twelve to twenty of the fourteens, and approximately forty mortars, with a large number of the smaller rapid-fire guns

Assuming the maximum, a hostile squadron would be greeted at each discharge of the entire armament with a composite thunderbolt weighing forty tons —forty tons of disabling, death-dealing steel each minute.

The old naval guns of our Spanish-American war period are obsolete. The guns of the civil war class are playthings; and all guns antedating that period of interstate war are as harmless to a modern dreadnought or emplacement, at any range, as the beating of the rain upon the sea.

And fifty years hence our latest perfection that we esteem so deadly will be smiled at in some musty old museum!

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Length, inches	590	579	200
Weight, pounds	284,000	138,000	34,000
Powder charge, pounds	650	320	60
Shell length, inches	70	62 6	30-39
Shell weight, pounds	2,400	1,660	1,046–700
Range, yards	18,600	18,000	19,000
Penetration, inches	17 all ranges 35 muzzle	13	any deck armor
[illegible]	1 per minute	1 per 40 seconds	1 per minute

Insects in the Upper Air

DR. E. EVERLING of Halle, Germany, is trying to interest aeronauts in making observations of the occurrence of insects at altitudes of several thousand feet above the earth's surface Very few such observations have heretofore been recorded. Dr. Everling himself, in the course of many balloon voyages, has only once noted an insect (a butterfly) at a great altitude. It was, in all probability, carried thither by the strong uprush of air in an incipient thunderstorm, and it may be a general rule that insects do not voluntarily rise above a moderate elevation. Aeronauts are invited to send their observations on this subject to Dr. A. Japha, Zoologisches Institut, Halle a. S., Germany. The meteorological conditions, and especially indications of the presence of strong vertical air-currents, should be noted in connection with all observations.

Meteorological Conference in Scotland.—It is the custom of British meteorologists to hold a breakfast or luncheon in connection with the annual meetings of the British Association for the Advancement of Science. As the Association is to meet this year in Australia, and few meteorologists from Great Britain will be able to attend, arrangements are being made to hold a conference of observers and students of meteorology and allied subjects in Edinburgh early in September.

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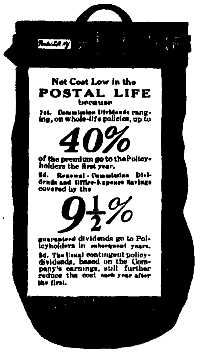
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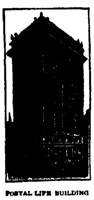
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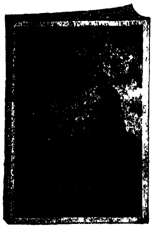

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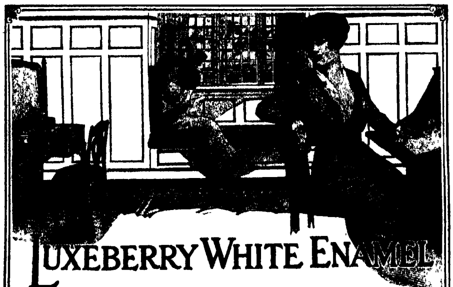

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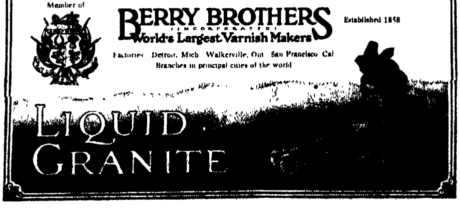

Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12981) O. O. B. asks: Can you please advise me if it has been positively proved that the electron theory of electricity, or, in other words, the one-fluid theory, is correct? That is to say, that it has been proved that positive electricity is fixed, while negative alone is movable? A The theory of electrons is firmly believed by most scientists. It probably may be said that it is proved as positively as any theory which may be modified at any time by some new discovery. No theory in science is regarded as absolutely proved. A theory is a statement which covers the phenomena to which it applies better than any other explanation If another better explanation is found, the old will be forced to give way to the new A recent work by J. J. Thomson, "Rays of Positive Electricity," pertains to this topic. We send the book for $1.40 postpaid.

(12982) M. A. G. asks: Will ultra-violet light penetrate ordinary glass, and also "Jena" glass, sufficiently strong enough to make an imprint on a photographic plate after it has passed through the above said glass? All visible light being excluded Some works which I have referred to, state that glass cuts off all ultra-violet light, while others state that nearly all of the ultra-violet light passes through. A. Glass is somewhat transparent to ultra-violet rays. We use a cobalt blue glass, combined with a violet glass colored with manganese, and we can get very good ultra-violet effects. By the use of quartz lenses and prisms we can secure much better effects beyond the violet of the spectrum which is formed. You will find about this in a very interesting book by S. P. Thompson, entitled "Light, Visible and Invisible," price $1.75 postpaid

(12983) E. G. M. asks: 1. In your paper of January 10th, 1914, page 43, you speak of the "daylight-saving fallacy." What is that? A The daylight-saving fallacy is that it makes a difference which hours men work if they only work the usual number of hours in the twenty-four. In some parts of Europe riots have been narrowly averted over this question, when it was proposed to have the men begin at an earlier hour in the morning so as to close the day's work earlier in the afternoon, and have time for the garden or other out-of-door pleasures 2. Would not people surely remain out of doors more, walking, playing, if daylight lasted longer after the day's work was over? I notice in the papers that some city near the dividing line between Eastern and Central time has decided to change to Eastern in order to have more daylight hours in the afternoon. A The sensible solution of the difficulty in keeping standard instead of local time is to change the hours of the day's working time as above rather than to lose the advantages of standard time In some cities where local time is about half an hour fast of standard time the shops and factories start at half past six instead of seven and stop for dinner at half past eleven by standard time. In reality the work begins at seven local time and the dinner is at twelve local time The day's work closes at half past five standard, but at six local time Thus the day is kept by the sun, but the hours are those of standard time. 3. I notice in the article referred to, in question 1: "It is stated that British Columbians now sleep during three hours of daylight in summer." Is this because their northern twilight is longer than ours, or do they get up so late? A Twilight lengthens rapidly in the summer as one goes north In the northern part of British Columbia there is little night in the summer, and men must sleep by daylight if they would get sufficient sleep. In the Arctic regions, men sleep by daylight all the time the sun is above the horizon without setting At Hammerfest there are eleven weeks of continuous daylight in summer, and the people keep the twenty-four hours as we do They open their shops at eight o'clock in the morning and close them at six of the afternoon, and sleep at the same hours as men do farther south but it is daylight all the time.

(12984) G. M. G. asks: A suitable container is completely filled with fresh water and hermetically sealed with the same material and of the same thickness as the walls of said container The temperature of the water is now lowered to such an extent that all the water in the container is frozen. Also kindly inform me of the expanding pressure, in pounds, of freezing water. A. Water cannot freeze unless it can expand The force of its expansion in freezing is the same as that required to compress it from the volume it has as ice to that which it had as water The compressibility of water is about 420 ten-millionths per atmosphere One volume of ice yields 0.9178 volume of water at the freezing point. It will thus require about 140 to 160 tons per square inch to prevent water from freezing, and your container must have this strength See Ganot's "Physics" for data on this point. We can send the book for $5.

(12985) P. A. C. asks: 1. Why are only three images of a point formed when two plane mirrors make an angle of ninety degrees with each other? A. When two mirrors make an angle with each other, there are as many images and the object as the angle is contained in 360 degrees. If the angle is 90 degrees, this number is four; one is the real object and the other three are apparent images. The places of the images are found by the rule that the image in a plane mirror is as far behind the mirror as the object is in front and in the perpendicular to the surface of the mirror drawn from the object. It is easy to draw the mirrors at right angles to each other, and prolong the lines to represent the apparent mirrors behind the real mirrors. Then locate the images by the rule above. 2. Will you tell me how to find, graphically, the number of images formed of a point, when the mirrors make an angle of 45 degrees? A With an angle of 45 degrees the method is the same. There will be eight sections in the circle formed by the mirrors, which are in the space behind the mirrors; in each there will be an image, to be located by the method given above. The images will be on the vertices of an octagon. This construction is the basis for the kaleidoscope.

(12986) F. A. G. asks: 1. Will you be kind enough to tell me if the optic nerve is composed of fibers, each fiber having one of its ends connected to the retina and the other end to the cerebrum? I would like to know if each connects one or more cells of the retina with one or more cells of the brain? A There is no difference between the transmission to the brain of a stimulus leading to sight and one producing any other sensation. The nervous system is the sum total of nerve cells, which are called "neurones" by the psychologist, and these act by conducting impulses from the point where the stimulus is applied to the part which can act upon that stimulus in the proper manner Just how a nerve cell conducts or transmits is not definitely known, but the fact is certain Light falls upon the ends of the neurones of the retina, and these act so that the stimulus affects the other end of the nerve cell which may be quite a distance away, and this remote end transmits the impulse along to other nerve cells, and finally it comes into the mental consciousness. It is not light which is transmitted, any more than it is sound which is transmitted over a telephone wire a thousand miles. The stimulus produces a sensation simply, but we call the sensation "seeing" 2 At the point of focus how is the motion or vibration of light transmitted to the fiber, and how is light reproduced in the mind? A Just what the mechanics of the production of a stimulus is, we cannot say. We have always thought of it as like the wind sweeping over a field of grain The heads bow to the breeze and rise again The vibrations of light are transverse, and so, although infinitesimal, may be able to set into vibration the microscopic fibers of the rods and cones of the retina. The texts of Psychology discuss these matters We can supply Thorndike's for $1.50, and James's for $1.75.

(12987) J. W. says: In the SCIENTIFIC AMERICAN SUPPLEMENT, No. 1985, page 48, January 17th, 1914, there was published a mnemonic in French for the ratio of the circumference of a circle to its diameter to 30 places of decimals, or 30 decimal *pi*. There was a humorous challenge to anyone to construct something of the kind in English. I accept that challenge, and submit the following as the best I can do with such restrictions as are imperative, i. e., each word must be composed of a fixed number of letters I believe that the rhythm will help the words to trip off the tongue fluently and render it easy to memorize.

Now I have a means wherewith to tackle—
3 . 1 4 1 5 9 2 6
every now poser inviting attention. Welcome
5 3 5 8 9 7
solutions may be met, although alas untrue.
9 3 2 3 8 4 6
An artful plan you got, enabling you to measure
2 6 4 3 3 8 3 2 7
quadrants.
9

In repeating these sentences it is convenient to stop at the word "tackle" and commence afresh, as at that point the rhythm changes. Of course, it cannot be expected that mnemonic sentences shall be beautiful models of language, but I must congratulate the composer of the French sentences on the success he has achieved. A question occurs to me, sir, as to whether any mathematician ever uses, or is likely to use, such an alarming mass of figures in his calculations. A. We note your lines for the ratio of circumference to diameter. Several have been sent in, and references to several which were printed in England several years ago. It is never necessary to use the figures of this number to the hundreds of places to which the calculation has been carried. We have employed fifteen figures in large computations in astronomy.

(12988) F. E. M. asks: Are two vertical lines ever parallel, and if so, under what conditions and at what point on the earth's surface? I am asking for absolute facts, and not what we consider to be parallel, such as the walls of a building. A. A vertical line is one which passes from the center of the earth to the zenith of any place. It is perpendicular to the surface of still water. Any other vertical line must, in a strict mathematical sense, make an angle with it, no matter how near it is drawn to it, since the only point in common to the two lines will be the point of their origin, the center of the earth. Two vertical lines near together are sensibly parallel. There is no instrument which could detect any convergence in two vertical lines on the equator, six feet high and one inch apart.

The [illegible] Sandwich

THE [illegible] interest in scientific circles as well as in the ranks of social workers concerning some of the problems of nutrition among the masses is exemplified by current discussions regarding school lunches, institutional dietaries, economical menus for the household, and the cost of living. These are constantly bringing out the fact that diet customs are subject to wide inequalities in character in different parts of the world and in different strata of society; and they further make it clear that food habits are not so fixed as was once supposed, but are varied to meet economic changes and alterations incident to the shifting of population. Rubner has remarked that the scene of the changes witnessed in the nutrition of the masses lies in the cities, the country districts representing the conservative factor and adhering more closely to the dictates of tradition. It is in the cities that the most noticeable of the modern changes in dietary customs, such as the increasing consumption of meat and the introduction of ready-to-eat foods, have first taken hold on greater numbers of individuals. Furthermore, the questions of diet in large institutions almost always need to be solved with reference to the local market conditions.

Max Rubner, the eminent physiologist and hygienist of Berlin, has lately presented some interesting data on one of the many transformations in dietary custom which is peculiarly conspicuous in the cities of Germany. It is the rapidly growing tendency to introduce widely what corresponds in general to the American sandwich (*das belegte Brot*) into the daily food-intake. Anyone who observes carefully the eating habits of workingmen in this country and who has followed the enormous increase in the lunch-counter scheme of dietetics among our own population, must admit that the sandwich is something more than a trivial incident in the nutrition of those who live in populous districts. Physiologically, it involves the supplementing of bread—the common "staff of life"—with considerable fat (butter) and animal protein (meat). The sandwich represents a new step in the evolution of bread-and-butter combinations. Rubner believes that the growing use of the meat-laden sandwich is attributable, in Germany at least, to the increased employment of tea and coffee, which require some substantial adjuvant, and also to the greater consumption of sugar and alcohol. The latter lead to a lowering of the protein of the diet, which is thus equalized by the albuminous sandwich. Added to these factors is the growing tendency, especially among the unmarried classes, to eat outside of the home and to patronize the rapid-service, time-saving, sandwich dispensing restaurants and eating-houses.

The average composition of the sandwich, if we may identify this for the purpose of argument with its German competitor, shows that it differs from plain bread in the predominant addition of fat with some increase in protein. One can attach but little value to the "average" composition of so heterogeneous a group of products as is represented by bread-and-meat mixtures of all varieties. Broadly speaking, the comparison afforded shows that 100 calories are distributed in the different food materials as follows:

	Calories		
	Protein	Fat	Carbohydrate
In bread	11	3	86
In bread and butter..	5	58	37
In meat sandwiches..	15	53	32

The great concentration of nutrients in a small volume in the sandwich at once becomes apparent here. The work of mastication is reduced and the entire make-up of the product encourages rapid eating with its possibly unfavorable consequences.

The sandwich, as here represented, exemplifies a tendency to increase rather than diminish the proportion of food of animal origin in the dietary of man; but aside from the fact that it is instituting a larger participation in the use of meat, and is thus working contrary to what many students of dietetics regard as desirable, this form of food is not as economical as is popularly believed. It is true that a palatable sandwich can be purchased for a few cents. The same proportionate expenditure in the household or in the purchase of a warm meal that deserves the name will procure surprisingly more nutriment, even in the more expensive type of restaurant. It has been calculated, for example, that twenty-five cents will buy:

	Calories		Gm. protein
In a public eating-house	3,990	containing	108
In a good restaurant...	1,990	containing	78
In form of sandwiches..	1,140	containing	30

The sandwich is frequently looked on as the "poor man's lunch" and current practice is tending to increase its use. If it is really desirable to increase the purchasing power of a small daily income so as to augment the part devoted to nutriment, the reform cannot be instituted by pointing to the supposedly inexpensive lunch counter. The boarding house and the home wisely administered on the dietetic side still remain the most economical as well as most rational centers for food reforms.—*Journal of the American Medical Association.*

What Is an Enzyme?

ALTHOUGH everyone realizes that enzymes are without question closely related to the life-processes of the cells, and are in some cases the products of their manufacture, it must still be frankly admitted that we have not yet succeeded in characterizing the so-called ferments as definite chemical substances. In truth, nothing conclusive can be stated as to their constitution, nor can they be classified consistently among any of the familiar groups of organic compounds which have a biologic import. Enzymes, in the past, have frequently been assigned to the category of proteins. The reason for this has been that the fermentative properties of certain solutions have usually been associated with the protein fractions contained therein. With respect to their behavior in precipitation, dialysis, alteration by heat, and other properties, the analogy between proteins and enzymes has appeared to be close; so that, pending the extension of knowledge with respect to the chemistry of proteins, some excuse was present for identifying the enzymes as protein in make-up. The enzymes are undoubtedly colloidal in character; and in order to isolate them in greater purity the methods commonly applied to other colloids have been used. The fact that many "purified" enzymes give protein reactions may merely mean that the albuminous material is dragged along mechanically in attempting to isolate the enzymes. Most of the methods for the preparation of them have been such as to justify this assumption. Ohta has succeeded in getting evidence of vigorous enzymatic activity in preparations that are actually free from protein. By digesting commercial emulsin—the enzyme which acts on glucosids like amygdalin—with pancreatic extracts, he has digested away the protein ordinarily found in the crude preparations on the market and has completely removed the proteolytic products by dialysis. The purified emulsin thus prepared was entirely devoid of protein, yet showed the typical hydrolytic action on amygdalin and salicin vigorously. The supposed protein attributes of enzymes must, accordingly, be abandoned.—*Journal of the American Medical Association.*

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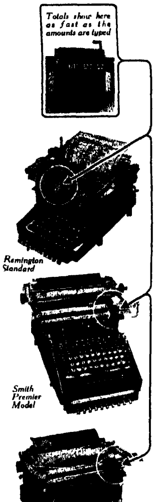

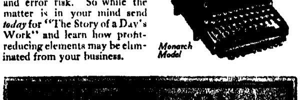

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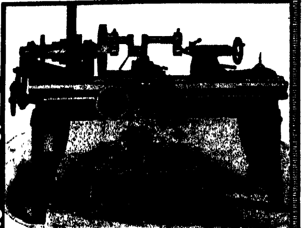

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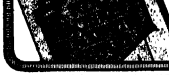

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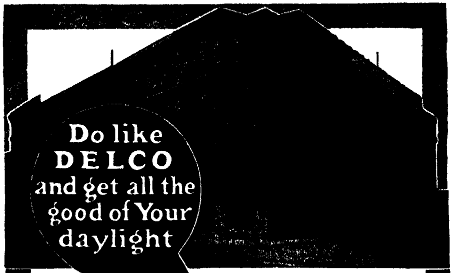

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See Sweet's Catalog, 1914 edition, pages 1916-1917

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NEW BOOKS, ETC.

Evolution by Co-operation. A Study in Bio-Economics. By Hermann Reinheimer. New York: E. P. Dutton & Co., 1913. 12mo.; 200 pp. Price, $1.25 net.

Huxley foresaw that later generations would accept the main doctrines of Darwinism "with as little reflection, and it may be with as little justification, as so many of our contemporaries rejected them." The work under review examines those doctrines in the light of modern research and demurs to the Darwinian position that battle, famine and death directly contribute to the production of higher types. A much more important factor, the author holds, is co-operative activity, with the dietetic and digestive modifications that accompany it. His views on natural and unnatural pabulum, and on digestive transformation, are extremely interesting, and are worthy of further development. It is not necessary for us to accept his low estimate of the Darwinian plane of investigation in order to appreciate his marshaling of what we prefer to call complementary rather than opposing facts. It is regrettable that the style of the work is rather more difficult than it need have been, but its nuggets are well worth digging for.

Electric Toy Making for Amateurs. By T. O'Connor Sloane, A.M., E.M., Ph.D. New York: The Norman W. Henley Publishing Company, 1914. 12mo.; 210 pp.; illustrated. Price, $1.

Under Prof. Sloane's cheerful instruction our boys may spend many happy hours at home in making and operating electrical apparatus and toys. The materials are inexpensive—the despised tomato can will serve for a battery—and the knowledge imparted by such a hobby never fails to prove useful in maturer years. Among the toys dealt with are the electrical dancer, the magic drum and electrical insects, while the more useful appliances and processes dispute precedence with the toys.

The Graphic Arts and Crafts Year Book. American Annual Review of the Printing and Allied Industries. Walter L. Tobey, Editor. Hamilton, Ohio: Graphic Arts Press, 1914.

The progress of the graphic arts in America is here embodied in a format of striking beauty and dignity The illustrations are eloquent examples of the perfection to which our manufacturers and craftsmen have attained. Types, papers, inks, equipment, processes, have all harmoniously advanced together, and the result is epitomized in the impressive reproductions of the Year Book. Processes are shown in their successive stages, page after page of color enlivens the instructive articles—and the letterpress, by the way, is in true artistic balance with the illustration and binding. There is an advertising review and critique by Marquis Regan, valuable papers on engraving and typography, descriptions of the modern pressroom and bindery, and a word on office and plant efficiency A study of the types, papers and setups exhibited in the volume would be of the greatest advantage to manufacturers, advertisers and commercial printers

The Truth About the "Titanic." By Colonel Archibald Gracie. New York: Mitchell Kennerley, 1913. 8vo.; 330 pp.; 16 illustrations. Price, $1.25 net.

This personal narrative, once started, is as difficult to lay down as a "best seller." Naturally, it adds nothing of scientific and practical value to what was brought out in the official investigations, but as a monument to Anglo-Saxon chivalry and bravery it is almost unique. Col Gracie went down with the ship, and only after an under-water swim of incredible duration was he able to climb upon the bottom of an overturned boat That his head was clear and his faculties alert, even in the moments of his greatest danger and physical strain, is a fact for which we should be grateful, since it has contributed to the sharp detail of his simple, manly account. We seem actually to share the long sufferings of the night until the black, menacing bergs take on robes of light with the same sunrise that brings the "Carpathia," like the incarnation of answered prayer, into view of the open boats and their frozen freight. An excellent feature of the work is comprised in the abstracts from the American and British Courts of Inquiry, which form an admirable supplement to the personal narrative Col Gracie died eight months after the disaster, his death being due to, or at least greatly hastened by, the experiences of that night of terror.

Bees and Wasps. By Oswald H. Latter, Senior Science Master at Charter House and formerly Tutor of Keble College, Oxford. Cambridge: The University Press. New York: G. P. Putnam's Sons.

Although this book is confined to British species of Hymenoptera, it can be read with profit by American readers; for it discusses in a simple way fossores or digger wasps, diploptera (double-winged wasps) bees (anthophila) long-tongued bees (Aphidæ) and the social bees. Most interesting is the description of the structural features, namely, of the sting and the tongue.

Floods and Levees of the Mississippi River. By Benjamin G. Humphreys, Member of Congress from Mississippi. Washington, D. C., 1914. 8vo.; 349 pp.

The congressman from Mississippi advocates the levee system for the control of floods, his work having particular reference to proposed legislation. He urges that the disasters affecting the valley of our great central artery of trade constitute national problems of vital importance.

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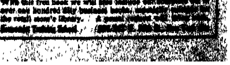

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Chemistry in America. By Edgar F. Smith, Blanchard Professor of Chemistry, University of Pennsylvania. New York: D. Appleton & Co., 1914.

Material on the development of chemistry in America is so scanty and so widely scattered that in gathering together much of it in this volume, Prof. Smith has performed a service which deserves the gratitude of every true student of American science The chemists who play a prominent part in the book are Robert Hare, James Woodhouse, Joseph Priestley, Thomas Cooper, John MacLean, Samuel L Mitchill, Benjamin Silliman, James C. Booth, T Sterry Hunt, J Lawrence Smith, Wolcott Gibbs, M. Carey Lea, J. Parsons Cooke, and J. Willard Gibbs. Prof. Smith has not made any effort critically to appraise the work of men who have made their mark in American chemistry. He has contented himself with presenting a very trustworthy and painstaking account of what they accomplished rather in the form of a chronicle. We wish that the work of J. Willard Gibbs, by far the most distinguished figure in the history of American chemistry, had been more fully dilated upon

The Evil Eye, Thanatology, and Other Essays. By Roswell Park. Boston: Richard G. Badger, 1913.

This book might well have been called "Studies in Human Stupidity." One reads the author's entertaining and instructive essays on the evil eye, thanatology, serpentism and serpent worship, the evolution of the surgeon from the barber, with a feeling that in this enlightened twentieth century we too may be committing blunders that will furnish interesting historical material for some satiric writer two centuries hence Dr Park seems to have done his work thoroughly and painstakingly.

Les Aveugles. Par Docteur André Curtil. Lyon: Henri Georg, Editeur, 1913.

French literary reviewers have hailed Dr. Curtil as a new Maeterlinck, and well they may His book, a wonderfully sympathetic and poetic production, is a veritable prose poem in its way Written by a scientific man whose professional life has been spent in an ophthalmologic clinic, a man who knows the blind as only they know themselves, the volume must be regarded as a great piece of literature. Particularly striking is its appealing and admirably written psychological study of the blind. Only a man touched to the very heart could have written that most pathetic portion of this book which deals with the efforts of the blind to grasp the meaning of the outer world with what senses they still have, but deprived of the most valuable of all organs

Electricity in Locomotion. By Adam G. Whyte. Cambridge: The University Press. New York: G. P. Putnam's Sons.

This book pre-supposes nothing but the most elementary knowledge of electricity, although it does contain a certain amount of technical description. It, therefore, lends itself particularly well for popular reading

Who's Who in Science. International. 1914. Edited by H. H. Stephenson. New York: The Macmillan Company, 1914.

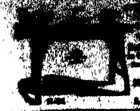
"Who's Who in Science" has now reached its third year The experience gained in publishing the two previous editions has evidently been most profitable, for not only are nine thousand scientists listed, but much valuable information on the world's universities and societies is given.

Formulaire du Candidat-Ingénieur. Par Maurice Percheron. Paris: H. Dunod et E. Pinat, 1914.

A vest-pocket compilation of definitions, classifications, tables and formulas, with a few blank leaves for written memoranda Geometry, trigonometry, the calculus, algebra, physics and chemistry each have their tiny section. Space has even been found for a few miniature diagrams

Exporters' Encyclopaedia. Tenth (1914) Edition. Containing full and authentic information relative to shipments for every country in the world. New York: Exporters' Encyclopaedia Company. 8vo.; 1136 pp. Price, including monthly corrections and the "Exporters' Review" for the calendar year, $7.50.

Those who have known the advantages of using as a desk guide previous editions of this work hardly need to be assured that in its tenth edition the same high standard of comprehensiveness and accuracy has been maintained. Among its hundred subjects are included lists of steamship lines, American consulates abroad, the countries of the world, banks and bankers in foreign trade, custom house brokers and export commission houses. There is valuable and immediately accessible information on such subjects as foreign currency, cable rates, consignments, consular regulations, financing of exports and forwarding concerns. The area, population, commerce and products of foreign countries are stated concisely The letterpress is interspersed with blank pages, on which the corrections received from month to month may be noted.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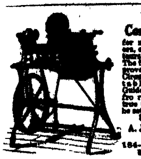
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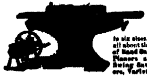
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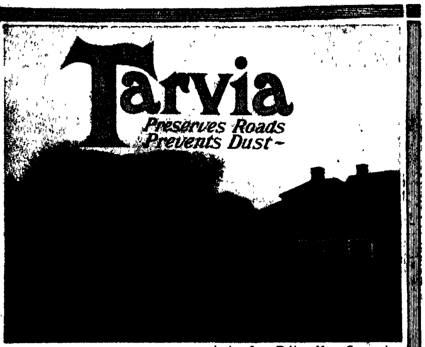

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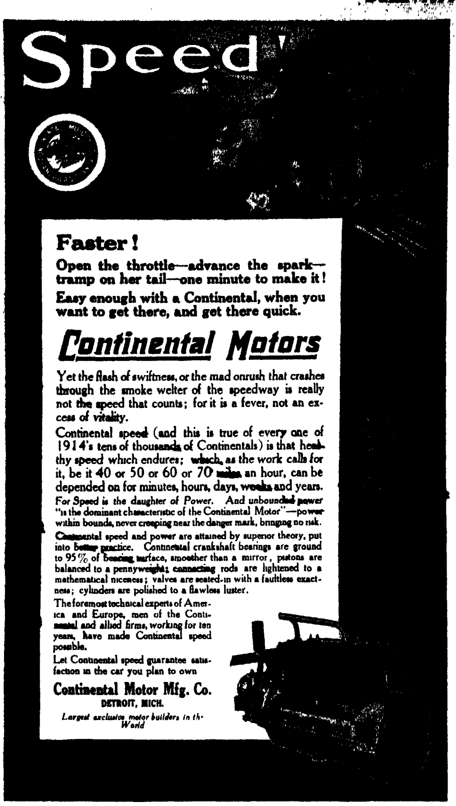

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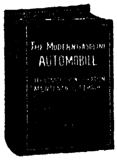

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Entirely new material has been added on tractors in three and four wheel forms, cyclecars and agricultural tractors or automobile plows; combination gasoline-electric drive, front-wheel and four-wheel drive and steer systems and other important developments in power propelled vehicles. The discussion of power transmission methods has been augmented by consideration of the skew bevel gear and two-speed direct drive rear axle, as well as several new forms of worm gear drive. The subject of electrical motor starting systems has been considered at length and all leading systems and their components described. A discussion on ball and roller bearings, their maintenance and installation, has also been included, and a number of other features of timely interest such as latest types of gasoline and kerosene carburetors, cyclecar power plants, the Fischer slide valve motor, detachable wire wheels, etc., have been added to bring the work thoroughly up to date.

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Machines and Mechanical Devices.

(Concluded from page 374.)

justable firing mechanism for submarine mines, by which the point of explosion of the mine on the side of a ship can be determined, and which can be examined at any time for regulation and keeping in repair.

AUTOMATIC TIME CONTACT SWITCH.—H. B. Meier, 222 Madison Ave., Port Chester, N. Y. This inventor provides a casing for a clock, said casing having a door closing the same so as to exclude dirt or other substances or conditions which might interfere with the proper operation of the clock mechanism, and said door serving, when closed, to make connection between the two parts of an electric wire, but so arranged that when the door is open, said parts are separated so that it will be impossible to complete a circuit from the battery until the door is again closed.

SANITARY TOWEL AND SOAP SERVICE.—C. H. Parvin, 147 Fern Ave., Collingswood, N. J., and M. L. Snyder, Wyncote, Pa. Address the former. This invention relates to automatic vending mechanism, and has particular reference to means for dispensing sanitary towels and soaps in public places. It delivers a quantity of soap, permits withdrawal of a certain amount of toweling of any suitable nature, and the operation of the mechanism for the purpose of initiating the movement thereof through the use of a coin or check serving to deliver the soap.

GATE LATCH.—D. Loudenslager, Rising City, Neb. This latch member is mounted on a gate post in such a manner that a catch of suitable device on the gate itself will, on closing, strike the latch and cause the latter to yield to permit the catch to pass to a position where the latch will automatically grip the catch and hold the gate closed.

ROAD SCRAPER AND SMOOTHER.—G. E. Tucker, Springwater, N. Y. The purpose here is to provide a structure which may be variously adjusted for causing the smoothing or scraping members to act all together or successively, and at any desired angle to the direction of travel of the device so that the road may be operated in substantially any desirable way according to the circumstances.

FIRING APPARATUS FOR MOORED TORPEDOES.—G. E. Elia, Rome, Italy. This invention relates to a firing apparatus for moored torpedoes or mines of the spherical or cylindrical type, and the firing mechanism relies for its actuation upon the well-known fact that a spherical or cylindrical torpedo acquires rotative motion from a vessel coming into contact therewith.

LADDER.—M. H. Hoffman, Box 83, Masontown, W. Va. This ladder is especially adapted for use on uneven ground, and wherein each of the stiles is provided at its lower end with an extension, capable of being moved longitudinally with respect to the stile, to lengthen the stile, and wherein mechanism is provided for operating the extensions simultaneously in opposite directions.

VENDING MACHINE.—S. C. Gilbert, Jackson, Ohio. Mr. Gilbert's invention relates to coin-controlled vending machines, and particularly machines for vending peanuts in packages. It is a design of the invention to provide an improved machine of the indicated character having a series of separate units, including carrying members and driven elements for actuating said members.

MACHINE FOR COVERING ELECTRIC CONDUCTORS.—E. H. Cook, care of Miss A. M. Harrison, 99 Keap St., Brooklyn, N. Y. The present invention relates to a machine for covering a wire or conductor with insulating material, and has more particularly reference to an improved structure for applying asbestos or the like to wire or conductor.

STRIP GUIDE FOR SEWING MACHINES.—F. L. Corson, 87 Winter St., Rochester, N. H. The device, which is preferably attached to a sewing machine, holds the ribbed portion of the canvas between the sides of the canvas in position, while it spreads the sides of the canvas, and holds them against the inner sole, while it is sewed thereto.

ATTACHMENT FOR STEREOPTICONS.—H. A. Gottlieb, 129 E. 59th St., New York, N. Y. The invention provides a magazine for holding lantern slides, with co-operating parts for successively permitting the slides to be positioned in front of the condensers, such operation, together with the consequent operation of taking care of the exposed slides, being under the control of the operator.

Prime Movers and Their Accessories.

ROTARY ENGINE.—E. F. Girod, P. O. Box 452, Monroe, La. An object here is to provide a novel form of device which will rotate in either direction by merely turning the valves of the intake and exhaust pipes. The invention provides a rotary engine having a novel form of valve operating mechanism, and a rotary engine having a pair of pistons acted on alternately at points 180 degrees apart.

Railways and Their Accessories.

STREET INDICATOR FOR CARS.—F. H. Webster, Marvel, Ark. This invention has reference to street indicators, and more particularly to street indicators carried upon cars, for the purpose of disclosing, to persons occupying the cars, the names of the streets, in successive order, as the cars travel along.

Pertaining to Vehicles.

AUTOMOBILE STARTER.—H. H. Moseley, 112 [illegible] The primary object of the invention is to provide an efficient [illegible] of operation by the [illegible] seat to impart initial [illegible] to the crank shaft of the motor for starting the latter, thus obviating the necessity of the chauffeur alighting from the car.

RADIATOR.—R. H. [illegible] Union St., Brooklyn, N. Y. This invention relates preferably to the type designed to remove the heat from the cooling water of the engine of an automobile or other vehicle, and the primary object thereof is to produce a radiator which will be of simple and practical construction, and at the same time operate with the highest possible efficiency.

ROTARY MEASURING DEVICE.—H. C. Spedden, Grangeville, Idaho. This instrument is for use in connection with vehicles for measuring the distance a vehicle travels on an imaginary horizontal line irrespective of the contour of the road on which the vehicle travels. While useful in this particular application it may be employed to make linear measurements generally.

LIMBER PIN FOR MINE SKIPS.—C. H. Sawyer and J. Bowditch, Newcastle, New South Wales, Australia. This improvement relates to devices for coupling a mine skip or like vehicle to animal draft gear, and has been designed to provide for that purpose an improved limber pin of simple and strong construction adapted to effect such engagement with the draw bar hook of said vehicle that the same may not become detached and withdrawn during progress of the vehicle, but further may be manually disengaged with facility.

AUTOMOBILE WRENCH.—P. S. Merrill, 185 Main St., Waterville, Maine. The object of invention No. 1,092,071, is to provide a simple, inexpensive and strong wrench combining the features of a monkey, pipe, and ratchet wrench designed for use in reaching any nut or bolt at any angle. This is obtained by providing a shank having an extension in the shape of a sector, a jaw pivotally mounted on the shank and associated with the sector, a second jaw slidably and adjustably mounted on the shank and co-operating with the first jaw and a handle adjustably mounted in the sector whereby the wrench is manipulated.

RESILIENT WHEEL.—P. F. Marcante, 429 Cedar St., Allentown, Pa. An object here is to provide a spring wheel structure in which the various springs are retained under a predetermined tension, and are all caused to act in unison when there is a sudden jar or load placed on the wheel whereby lighter springs may be used, as all the strain of a sudden weight or jar does not come under a single spring.

SNOW PLOW.—W. L. Stadig, St. Francis, Maine. This invention provides co-acting means for taking up the snow and causing it to be raised and deflected to the side of the road. It removes snow from highways, logging roads, and the like. It provides means associated with the rotary elements, and adapted to gather the snow to the latter, the said means being arranged for adjustment to the road level, or to leave a "comb" in the road center.

ROAD WAGON.—A. Macdonald, Bundarra road, Inverell, New South Wales, Australia. The present invention has been devised to provide a combination four wheeled farmer's wagon and tip-dray so arranged that the rear portion of the wagon may be tipped and is detachable for separate use as an ordinary two wheeled tip-dray.

SPRING WHEEL.—R. Fourchy, 211 Post Office, Kansas City, Mo. This invention refers to spring wheels for vehicles and has reference more particularly to the resilient connection between the rim and the hub, said connection comprising a plurality of independent resilient units located between the spokes and intermediate the rim and the hub.

LAMP MECHANISM FOR AUTOMOBILES.—R. C. Browne, Lock Box 257, Cons, Ill. This invention provides a lamp mechanism controllable automatically by the steering wheels and parts connected immediately therewith so that when the steering wheel is turned the lamps of the vehicle are turned to correspond with the angular direction in which the vehicle is turning.

Note.—Copies of any of these patents will be furnished by the Scientific American for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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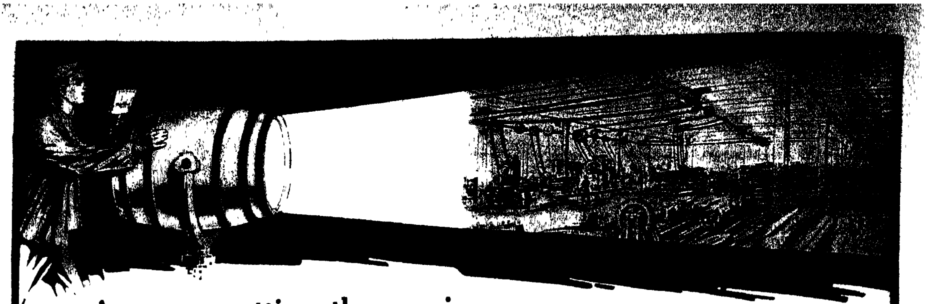

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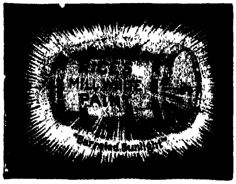

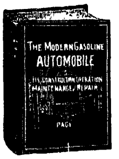
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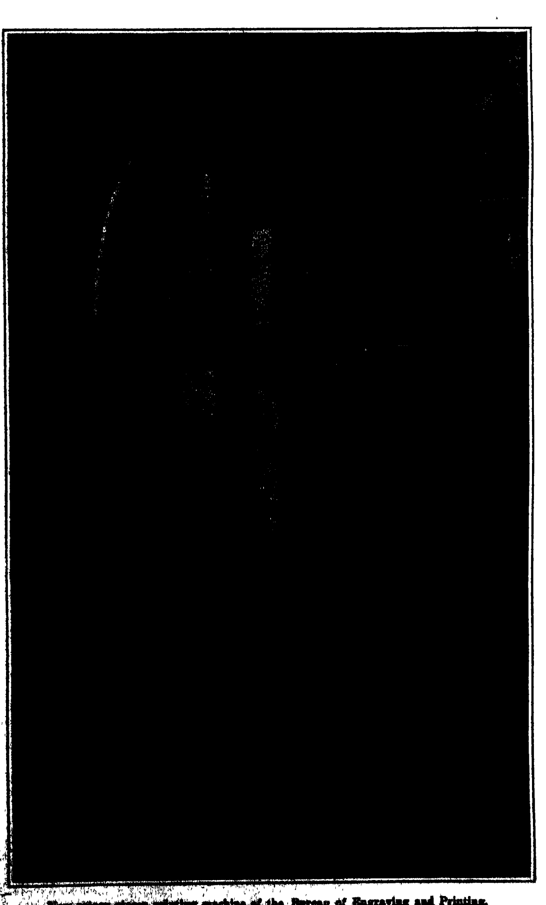
WHEN a man purchases a penny postage stamp, he is quite apt to overlook the cost of producing that stamp and think that the whole of his investment will go toward paying the expense of sending his missive to its destination. To be sure, the cost of production is almost negligible when calculated for a single stamp, but when he learns that about forty million stamps must be printed daily to supply the demands of our letter writing population, he realizes that the annual bill for printing postage stamps amounts to a very considerable figure.

The manufacturing cost has been reduced materially of late by the inventions of Mr. Benjamin R. Stickney, mechanical expert and designer of the Bureau, working under direction of Mr. Joseph B. Ralph, Director of the Bureau of Engraving and Printing. As postage stamps are printed from engraved plates, the ordinary high-speed printing processes are not applicable to them. Ordinarily, it is necessary to moisten the paper so that it may readily be pressed into the engraved lines of the plates to pick out the ink that fills them. The common press cannot exert sufficient pressure upon the paper to make good prints if the paper is dry. And so up to a recent date all the paper had to be moistened by hand, which was a slow and costly process. Then about four years ago Mr. Stickney invented a machine for wetting paper, and he followed this up two years ago with a stamp printing machine that would print on a roll of dry paper. Not only did this eliminate the bothersome operation of wetting the paper, but it reduced the clerical work of keeping track of the separate sheets on which the stamps were printed; for now they were printed on continuous rolls at the rate of 12,000 postage stamps per minute.

This high-speed machine has since been further improved, and it now appears as in the accompanying engraving. The paper is fed from the drum shown in the foreground. It passes up over rollers, and then down between the feed roller and the printing cylinder. Here an enormous pressure is put upon the dry paper, which forces it into every line of the engraving. At the back of the cylinder is the inking font, below which are metal fingers, covering a space about 8 inches wide and extending the full length of the cylinder. The fingers vibrate lengthwise on the cylinder. A wiping belt vibrates with the fingers, but at the same time moves forward, wiping the surface of the cylinder as clean, as if the work were done by hand.

In Mr. Stickney's first machine, the paper passed from the printing cylinder over a series of electrically heated rollers to dry the ink. In the present machine the strip of stamps passes upwardly, and, in the language of the Bureau of Engraving and Printing, "loops the loop" over a long curved copper plate heated by electricity, as may be seen in the [illegible] of [illegible] engraving. [illegible] then passes under a roller at the extreme lower front and proceeds rearwardly to the gumming font. After being automatically gummed, it passes into a steam-heated drying shaft about 25 feet long. From the drying shaft it enters the perforator and slitter and is discharged from the machine in long strips that are coiled up like ribbon.



New rotary stamp printing machine of the Bureau of Engraving and Printing.

An Underground Canal

A PIECE of engineering work of considerable scope in the shape of an underground canal is now going on in the south of France, the object being to complete the waterway across the country. Starting from Havre, boats can pass by the Seine, the Saone and the Rhône with their junction canals as far as Lyons and from there to Arles, but access to the Mediterranean is prevented on account of the fact that the Rhône is no longer navigable after that point. Work is now carried out upon a canal which will make connection from the Rhône at Arles to Marseilles, of about fifty miles length. On the course lies the large lake known as Etang de Berre, which will be reached by open canal. From the lake to Marseilles a mountain chain cuts off the way, so that the canal must be run in tunnel from here to the sea. As the underground canal needs to be of large section, and is some 4½ miles long, this represents quite an undertaking, and will use most of the $15,000,000 allotted for the canal enterprise. A circular arch section is used, with narrow towpath on each side, the width of the section being 73 feet and height 51 feet, so that its section will be eight times that of the Paris subway. The canal itself occupies a rectangular section 10 feet deep and 60 feet wide. At present this work is under way, and will represent some 2,000,000 cubic feet of rock excavated and emptied into the sea. Electric cables bring over 2,000 horse-power for the drills and other machines, besides the electric locomotives for spoil trains. The canal will be on sea level as far as Arles, with locks from thence to the Rhône level. Great economic consequences are expected, and the above-mentioned lake will form an inland sea depending on Marseilles, and its shores will no doubt be covered with maritime and industrial establishments. Marseilles will now become a river port as well as a seaport, and Lyons will connect with the Mediterranean.

How Paris Disposes of City Waste

QUITE an elaborate system is soon to be put in operation for disposing of the great amount of household waste of the city of Paris. At present there are used 730 large wagons of 180 cubic foot capacity, 1,500 horses, and 3,000 men, and the annual amount is estimated at 900,000 tons, or 2,600 tons per day. On the old system, Seine flats took the material either to sea or river points, or it was transported to the surrounding country. But a modern method is to be organized which involves the use of electric trucks and a system of five large consuming plants in the suburbs at different points around the city. Two of the plants are now in operation, and the electric trucks are being introduced by degrees. At the St Ouen consuming works all is laid out on approved ideas, and the electric trucks discharge automatically into a pit 300 feet wide, at the bottom of which is a set of belt conveyors for taking the material either direct to the grinding mills or to the consuming furnaces. Other conveyors take the material and discharge it into silos above the furnaces. After combustion at about 1,000 deg. Cent. there is left a residue resembling slag or clinker. Suitable means are provided for taking the clinker to a mill, where it is ground and mixed with lime so as to make up bricks. Hot gases from the furnaces serve to heat the boilers and supply steam turbines for producing not only all the power needed on the premises, but a considerable amount sent outside. As much as 900 tons of waste is handled per day.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Plans of the Cup Defenders

WE direct attention to the unusually complete plans of the cup-defenders of the "America's" Cup, which were published in the last issue of the SCIENTIFIC AMERICAN. This material is presented in recognition of the widespread interest which is aroused whenever a challenge reaches this country for a series of races for the greatly coveted yachting trophy.

In no previous contest has so much informing data been available thus early in the season. It has been withheld from publication until the construction of the yachts had reached a stage at which it was too late to make any alterations, either in hull or sail plan, based upon "what the other fellow was doing."

The three designers, Herreshoff, Gardner, and Owen, have worked absolutely independently of each other—and the result has been the production of three widely different yachts, and a complete covering of the field. Nicholson, the designer of the "Shamrock IV," is "up against" a strong combination, and if the visitor, after crossing three thousand miles of ocean, and competing in unfamiliar water, can win the cup—so much the greater will be his glory!

The Plight of the Railroads

LET us be fair to the railroads. They are asking the Government to permit them to make a moderate increase in rates, basing their plea upon the ground that the increase both in wages and in the cost of materials of late years has been so great as to make it necessary for them to increase their freight rates if they are to maintain their systems in good condition and return a reasonable profit to the stockholders.

Is this request a reasonable one? It is our belief that a review of the facts would justify the Interstate Commerce Commission in permitting many, if not all, of the railroads which have preferred the request to make the desired increase Every one knows that the cost of labor and the price of materials and of all purchasable commodities have been increasing, in many cases, by leaps and bounds And it by no means follows that because a corporation's activities involve the turning over of hundreds of millions of dollars a year, that therefore it has not in considerable measure felt the pressure of these changed conditions

We have before us some statistics regarding the New York, New Haven, and Hartford Railway, which have been sent to us by its new president, Howard Elliott The pamphlet presents facts and figures regarding the situation on one of our leading railroads, of the correctness of which there can be no doubt whatsoever. Regarding the increased pay of employees, it is sufficient to say that three reports made by the New Haven Railroad to the Interstate Commerce Commission for three periods, five years apart, show that the average yearly wages based on the number of men employed have risen from $633.69 in 1903 to $763.38 in 1908 and $815.49 in 1913. In the ten years from 1903 to 1913 there has been an increase in the number of men employed of 11 per cent; an increase in the total compensation of 43 per cent; and an increase in the average yearly wage of 29 per cent. Furthermore, we are informed that during the fiscal year ending June 30th, 1914, the increase in the rates of pay will have increased the total payroll about $900,000 over the previous year.

There has been a large increase in cost of railroad operation, etc., due to legislative acts and requirements. Thus the Nine Hour law, the Ash-pan law, the Safety Appliance law, the Boiler Inspection law, and the Full Crew law, have increased the expense of the company nearly $200,000 per year. Ten years ago the cost of accounting was $190,000 per year, to-day it is about $500,000 per year, and part of this increase is due to the accounting requirements of the Interstate Commerce and State Commissions. The Federal Act calling for the valuation of railways will add another $60,000 per year to the expenses of the company. Commenting on these facts, President Elliott says that they are not quoted in any spirit of criticism, but merely to show the effect that they have had upon the income of the company.

On the question of freight and passenger rates, we learn that, although the capital investment of the company and its operating expenses have been increased, the freight rates on the whole have remained stationary or have decreased. Thus, in ten years there has been a reduction of 69/1,000 of a cent in the average rate received for hauling 2,000 pounds of freight one mile. Now this seems to be a very small sum; but when it is applied to the frieght business of the New Haven Road for the year ending June 30th, 1913, it is found that it represents a loss of freight earnings of $1,800,000. The increase in wages and the decline in freight rates, alone, make a difference of over $9,000,000 a year in income, equal to 6 per cent interest on a capital of $150,000,000.

An interesting fact in connection with the New Haven Railroad is that it is essentially a passenger railroad; for whereas on the railroads of the country as a whole two tons of freight are carried for each passenger, on the New Haven only one third of a ton is carried per passenger. During eight months of this year, the passenger earnings were 50.6 per cent, and the freight earnings 49.4 per cent of the revenue from transportation. The revenue per passenger train-mile was $1.90 and per freight train-mile $4.17. Again, the commutation and trip-ticket passengers, which are the unremunerative class of passenger travel, comprised 43 per cent of the total passengers carried, and they yielded only 13.6 per cent of the total passenger revenue. Taken as a whole, President Elliott states that, because of low passenger fares and the increasing cost of service, much of the passenger service is operated for the convenience of the public at a positive loss, and the whole passenger service only just pays its operating expenses. Hence the justice of making a reasonable increase in the passenger rates is obvious.

Reconnoitering at Santiago and at Vera Cruz

THE events of the Spanish-American war are not so far removed but most of us have a distinct recollection of the anxiety which was occasioned by the dispatch of Cervera's squadron of four armored cruisers and some torpedo-boat destroyers from Spanish to American waters. It was known that Cervera had sailed; but as to his destination there was, even in our Navy, considerable doubt and much resulting perplexity. As will always be the case in hostilities involving naval operations, our towns and cities along the seaboard became suddenly aware of the vast importance of a navy, and the timorous property holders and municipalities clamored loudly for the protection of a cruiser, battleship or something that could shoot with big guns. Meanwhile, when our scouts, improvised and otherwise, were scouring the seas in search of the Spanish admiral, he had slipped quietly into Santiago harbor, where he lay snugly screened from observation behind the rather lofty hills which encircle that anchorage.

Nor have so many years intervened since that interesting episode but most of us will recall the long-range observation of the entrance to Santiago harbor by Admiral Schley, and the many speculations indulged in by himself, the public press, and everybody else, as to whether the Spanish ships were or were not hidden inside the snug little harbor.

Vastly different are the conditions sixteen years later at the port of Vera Cruz, Mexico—different, that is to say, so far as the question of obtaining accurate information of the strength and location of the enemy is concerned. Although our enlisted men and marines had landed in considerable force and held the city, there was considerable uncertainty as to number and position of the enemy's forces outside the city. Rumor had it that heavy reinforcements had been dispatched from various points to Gen. Maas, who had been in command at Vera Cruz, and it was stated that he was making ready for an attack on the city with overwhelming numbers. Most important was it that Admiral Fletcher should be informed on this point and learn what was the condition of the railroad line from Vera Cruz to Mexico, and particularly of some important bridges on that line. It was impossible to spare sufficient officers and men for an adequate reconnaissance, and for a while the situation appeared to be somewhat critical. Then there steamed into port the "Mississippi," and [illegible] her arrival, the naval aeroplanes and [illegible] were making a searching reconnaissance of the surrounding districts about Vera Cruz and along the route of the railroad. The Mexican forces, very limited in number, were located, and the whole military situation in and about Vera Cruz was cleared up.

There is a world of significance in a comparison of the situation at these two ports in the West Indies and the Gulf; and once more the aeroplane has proved its inestimable value as a means of obtaining definite knowledge of the strength and position of the enemy.

Annual Loans for Naval Construction

WE direct attention to the letter signed "Navy" in our correspondence columns, which draws attention to startling conditions in the naval situation. The author is well known to us, and is one of our most capable naval officers, who has spent many years abroad in close touch with the naval and diplomatic situation.

The statement that some of the leading powers are supplementing their first annual naval appropriations with large annual loans, spread out over a number of years, does not surprise us. Increasingly, it is being understood that the command of the sea may mean the command of the whole situation, military as well as naval—and particularly so in the case of nations which possess an extensive littoral or an oversea trade of large proportions. The determined way in which Germany, France, and Japan are building up their fleets is not to be attributed to any mere "jingo" spirit. The motives that prompt the policy are of a lofty and patriotic character, and these large increases are the result of a broad, intelligent, and thoughtful review of the whole international situation.

The facts brought out in the letter referred to point with increasing emphasis to the need for the formation of a Council of National Defense—a representative body, with the President at its head, which, after a review of the whole naval situation the world over, shall determine upon a fixed policy of naval construction, based upon our present and probable future necessities.

Predicting Nile Floods

THE prediction of the Nile flood has been a cherished ambition of the Egyptian meteorological service for a number of years. The stages of the Nile depend upon the rainfall of Abyssinia, and this, in turn, is supposed to be supplied by moisture-bearing winds blowing across the continent from the Atlantic Ocean. Accordingly the attempted predictions are based upon observations of pressure and wind velocity at St. Helena, and pressure in South America, which indicate the activity of the atmospheric circulation over the South Atlantic. It has been found that the mean error of a prediction from these data for the mean height of the Nile at Halfa between July 16th and August 15th, which normally corresponds to the middle of the rising stage, is ± 0.33 meter, whereas a prediction that assumes that the river will be normal in any given year would have a probable error of ± 0.55 meter. According to Mr. Hurst of the Egyptian Meteorological Office, this result is sufficiently encouraging to warrant a continuation of the investigation, considering the vast importance of the problem to the welfare of Egypt.

The Cooling of the Earth

THE application of Stefan's law to the calculation of the mean temperature of the Earth, at a given latitude, shows that at the latitude of 80 degrees, the temperature was in the neighborhood of 90 deg. Cent., when the Sun's radius was about one and a half times its present dimensions, i. e., about two million years ago. Thus it would appear that life commenced on the Earth in the vicinity of the poles. The same reasoning leads us to the conclusion that in less than two million years, when the Sun's radius will be reduced by one tenth of its present value, the temperature on the Earth will have fallen below 0 degree, even at the equator.

Evaporation and Stream Flow

AN investigation of evaporation and stream flow is being carried out by Prof. John F. Hayford of Northwestern University with the aid of a grant from the Carnegie Institution. Instead of using apparatus on a small scale to measure evaporation, Prof. Hayford proposes to consider each of the Great Lakes in turn as an evaporation pan, evaluate the income, outgo (other than evaporation) and change of content of the lake, and from these data to determine the daily evaporation in its relation to meteorological conditions. Ultimately the knowledge thus acquired will be applied to a study of the laws of stream flow in the United States.

[illegible]

[illegible].—The statement that graduates of engineering schools do not follow the engineering profession is shown to be erroneous in the case of those of the College of Engineering of the University of Illinois. Data recently collected by the College show that of the 2,185 graduates, [illegible], or 89 per cent, are engaged in one way or another in engineering work, and that only 178, or about 8 per cent, have gone into other fields.

A Japanese Test Car.—A dynamometer car which has been designed for the Imperial Government Railways of Japan by Prof. E. C. Schmidt of the Railway Department of the University of Illinois, is expected to be received at Urbana this month, when the final assembling will be done. This car is being built by a prominent Chicago manufacturing company. After it has been assembled at Urbana it will be given a short preliminary run to see that everything is working perfectly, and will then be taken apart and shipped to Japan.

Preparing for the San Francisco Exposition.—By way of preparation for the heavy travel which is expected in connection with the Panama Exposition at San Francisco, the Union Pacific Railroad Company has recently placed an order for 54 locomotives costing about $1,000,000. Twenty-five of these are of the Pacific type, 15 are Mikados and 14 are of the six-connected type. Forty of the locomotives will go to the Union Pacific, 10 to the Oregon Short Line and 4 to the Oregon-Washington line.

The New German Torpedo.—The latest dreadnought cruisers and destroyers of the German navy, including all built since and during 1909, are armed with the new 21.6 torpedo, which is about 17 feet long and carries a bursting charge of no less than 290 pounds. The range is 7,500 yards, and the explosive in the head is known as trinitrotoluene, which is far more powerful than the guncotton used in the old 18-inch torpedo. In fact, the Germans believe that a single hit from the new torpedo would disable even the largest of the present dreadnoughts.

Herald Square Subway Station.—Construction of the new express station of the Broadway line at Herald Square will constitute this one of the most important traffic centers in this city. When the station and the extension of the Hudson tubes to the Grand Central Station have been completed there will be no less than six separate transit lines at this point, including three surface car lines, the Sixth Avenue Elevated, the Broadway line and the Hudson tubes, the whole being carried at four different levels. This station will reach from 32nd Street to 35th Street, and will be provided with eleven separate entrances.

Steam Turbine Pumps.—In Germany the first water works to recognise the many advantages of the steam turbine pump, as embodied in the new Allgemeine machines, was the one situated at Beelitzhof Works. Compared with the piston machines already in use there, it was seen to be much better, and this led the company to put in a new group having an output of 1,200 cubic feet a minute with a lift of 200 to 350 feet. This group is of improved type, with a steam turbine coupled on the same base to a rotary pump. All the water elevated by the pump is made to pass through the condenser (placed in the basement), so that an excellent cooling effect is the result, and the quantity of water is so large that it does not heat up to any extent.

Mississippi River Bridge to be Built at New Orleans.—It seems that the project of a bridge over the Mississippi near New Orleans, first proposed in 1888, is to be put through. The original design was for a crossing about four or five miles above New Orleans, where no change of bed or banks has occurred in the recorded history of the river. The span of the cantilever bridge was to be 1,070 feet between centers of main piers, the suspended span being 440 feet long and the anchor arms each 660 feet 8 inches in length. The foundations were to extend to 170 feet below low water and were to rest upon a bed of firm sand. The piers were to be sunk by dredging through open wells or cylinders. The present plan calls for a double deck bridge, one deck for highway and electric railway travel, and the other for railway service.

A New Road-Mending Machine.—An experimental test has been made in Paris of a portable road-mending machine, consisting of a six horse-power gasoline engine, actuating an air compressor, the air being led from a storage tank to a pneumatic rammer and a pneumatic pick, the latter being described as merely a modification of the well-known pneumatic riveter. The workman holds the tool close to the road and pushes the pick under the surface, raising it up as he proceeds. It is said that the work was done at a much faster rate than was possible with the ordinary pick. The pneumatic rammer also gave good results. One advantage of the system is that several men can work from the same compressor plant. The trial seems to indicate that mechanical road-mending is more effective than the present method.

Automobile

Catering to Convenience.—The manufacturer of a British car has provided an exceptionally simple means for cleaning the fuel tanks on his cars. He has merely made the filler cap large enough to admit a man's hand and arm. Incidentally, the large filling orifice facilitates replenishing the supply and as it makes possible heavy, substantial threads on the cap it eliminates the chance of their failure.

Protecting the Chauffeur from Head-Lights.—In patent 1,089,539 Theodore P. Driver of Melrose, Mass., shows a pair of chauffeur's spectacles in which are provided a row of three or more vertically arranged non-contiguous slats or screens. These are so arranged that the space between them is such as to afford no material obstruction to the straight ahead view, although they will operate to cut off the rays from approaching head-lights.

A Timing and Indicating Device for Vehicles.—John F. Burns of San Francisco and his assignees, Robert Colman and F. M. Auliffe, both of the same place, show in patent No. 1,090,382 an apparatus for indicating the letting of vehicles, which apparatus has a suitable timing and indicating device actuated by the seating of a passenger, the door of the vehicle controlling means for interrupting a movement of the timing and indicating device.

Germany's Municipal Motors.—A careful circular campaign has revealed that of 58 German cities having populations of more than 80,000, only 5 are without municipal motor wagons; one of these has a vehicle on order. The number of vehicles in each city varies from 1 to 52 per capita, the total number being 590. Of these, the fire brigades have 249; street cleaning and watering, 113; and ambulances, 54; the remainder are used for miscellaneous service.

A Two-Cycle Engine Competition.—By way of stimulating interest in the two-stroke automobile motor, the Royal Automobile Club of Great Britain, which already has done much to advance automobile science, has decided to organise a competition for motors of that kind. So far, nothing regarding the test has been permitted to become public, except that the test will require the engines to be fitted to a chassis and submitted to the Technical Committee of the club for certified trials. Further details probably will be forthcoming in the near future.

Agricultural Motor Trials for Africa.—There will be held in Tunis, Africa, from April 15th to 22nd, a series of tests of agricultural motor apparatus which have been organized by the General Direction of Agriculture and Commerce of the Tunis Government. Under the head "Concours de Motoroulture," they will comprise tests of all kinds of motors, wagons, tractors and general agricultural vehicles. Prizes to the amount of $6,000 are offered for best performances. The tests are conducted by the Direction Generale de l'Agriculture, 76 Boulebard Bab Benat, Tunis, North Africa.

Promise for Four-Wheel Drive Tractors.—As a result of the tests of four-wheel drive tractors, which have just been completed by French army authorities, it is likely that the number of these vehicles in use in the army will be increased. Thirteen vehicles were tested and all of them proved remarkably efficient; there were no mechanical troubles. The rules of the competition required that four-cylinder motors be used and that carbureters operate equally well with gasoline, alcohol or benzole. Some of the vehicles showed as high as 40 ton-miles to the gallon of fuel. The average consumption of the heavy tractors was 1.3 to 2.2 miles per gallon of fuel; of the light ones, 3 miles to the gallon. The supreme test required that the tractors ascend a 22 per cent grade carrying their rated capacities; no trailers were hauled in this test. All of the vehicles ascended without trouble, though but one was able to remain stationary on the hill with only one set of brakes applied.

Remarkable Strength of Steel Wheel.—In a recent test of wire, wood and steel wheels conducted by the University of Michigan, the steel wheel came out with flying colors. It successfully withstood a lateral pressure of no less than 8,940 pounds to the square inch. The tests were made in a Riehl machine. The load increments, applied at the wheel rim, horizontally, were 500 pounds and the deflections shown were as follows:

DEFLECTION IN INCHES.

Load Pounds on Rim.	Steel Wheel.	Wire Wheel.	Wood Wheel.
500	0.001	0.001	0.013
1,000	0.041	0.030	0.033
1,500	0.055	0.120	0.075
2,000	0.068	0.215	0.121
3,000	0.099	0.425	0.210
4,000	0.110	0.533	0.312
5,000	0.143	.....	.....
6,000	0.233	.....	.....

The wood wheel failed at 4,500 pounds; two spokes in the wire wheel broke at 4,000 pounds, though no nipples pulled through the rim.

Astronomy

The New Comet Recently Discovered by Kritzinger in Germany has been observed by Dr. William R. Brooks, professor of astronomy at Hobart College, Geneva, N. Y., from the Smith Observatory. Its position on April 23rd was right ascension 17 hours 41 minutes; declination north 9 degrees 41 minutes, near the head of Serpentarius, with a daily motion of about one degree in a northeasterly direction. The comet is quite faint telescopic, a broad diffused nebulosity with slight central condensation and no tail. It is growing brighter, arriving at perihelion, or nearest to the sun, the last of May.

The Total Light of the Stars.—Dr. Chapman read a paper before the Royal Astronomical Society describing investigations made on the total light of the stars. The results show that the total light from the stars is about equal to that which would be given by 630 stars of the first magnitude. The light given by stars of each magnitude increased from the first magnitude down to the tenth, the decrease in brightness of the individual stars of the successive magnitudes being more than compensated for by the increase in the number of stars belonging to that magnitude. But below the tenth magnitude this is no longer the case, the light falling off more and more as we descend the scale.

A Meteorite from Zululand.—Prof. Stanley describes the fall of a meteorite in the N'Kandhla district of Zululand, which took place on August 1st, 1912. An explosion took place, which was audible over a considerable area, and a rapidly moving body was seen accompanied by a spiral trail of smoke and emitting a rumbling or crackling sound. The meteorite discovered by Prof. Stanley fell within a few yards of a native woman. It weighs nearly 38 pounds, and consists almost entirely of nickel-iron alloy, and is therefore classed as a siderite; it is coated with a skin of magnetic oxide exhibiting flow lines and shows numerous "thumb marks." An analytical investigation shows the presence of iron, nickel, silicon, sulphur, carbon, phosphorus, aluminium, magnesium, platinum and chlorine, the bulk of the meteorite being composed of iron.

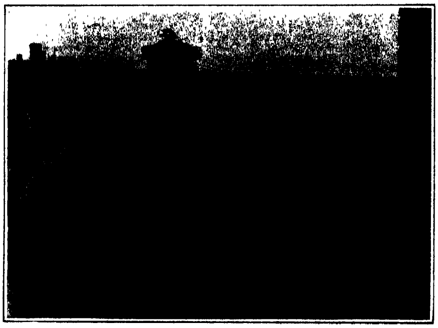
The Stability of the Solar System.—A law connecting the distances of the planets of the solar system from the sun has been discovered by Beldt, which is in close agreement with the observed facts. The mere existence of such a law throws light upon the stability of the solar system. A century ago Lagrange and Laplace thought they had demonstrated the invariability of the mean distances of the planets, and from that the stability of the solar system. But the mathematical series used in this investigation have been shown by Poincaré to be divergent, and therefore, so far as those calculations go, the stability is uncertain. If, however, the distances of the planets had been changed since the origin of the world by the action of the tides, their mutual attraction, etc., and if the perturbations so caused had accumulated, they would have been different for different planets, and no law connecting the distances of the planets and their satellites would have been discoverable.

Astronomical Telegrams.—The last annual report of the Director of Harvard College Observatory reviews briefly the telegraphic arrangements by which announcements of important astronomical discoveries and observations are given to the world. The distributing center in America is the Harvard Observatory; in Europe, the Kiel Observatory. A new object discovered in one continent is likely to be observed in the other on the following evening; hence the necessity for this prompt interchange of information. The expense of cabling American observations to Kiel is borne entirely by the Harvard Observatory. Cablegrams received from Kiel are generally distributed in this country by "night letter," and may thus be transmitted in ordinary language instead of cipher without increasing the expense. They are sent to all institutions and individuals who express a wish to receive them and who are to pay the telegraph charges from Harvard. During the year ended September 30th last, 33 telegraphic announcements were made, mainly relating to the discovery of comets.

The Shape of the Earth.—On the earth and on Mars the oceans dominate the austral hemisphere. This fact may be attributed to the translation of these two planets in a south-north direction across the primitive nebula. The rotation so set up would result in the production of cold currents which might cause the temperature to become inferior to 364 degrees, the critical temperature of water, and the currents would be such as to cause the condensation of the oceans to be produced round the South Pole, and to determine that the direction of the currents should be toward the equator, which explains the pointed form of the austral continents. The theoretical calculation of the velocities of these currents and the amount of solid matter transported by them is verified by direct measurement. Thus, 2,000 meters beneath the surface of the sea, the magnitude of the oceans is constant on the parallels of the austral hemisphere, and the magnitude of the continents is constant on the parallels of the boreal hemisphere.

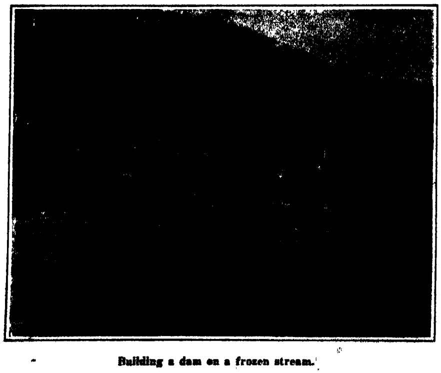
Hydraulic Train Stops

THE sudden stopping of trains at terminal stations has long been a source of continual annoyance to travelers, and in many cases has been the cause of serious accidents. A train stop, or what is technically known as a "buffer," that will reduce the speed and concussion of the incoming train to a small fraction of resistance, has long been needed on most of our railways. A hydraulic buffer of very interesting design has been developed by a firm of English engineers. It will resist and stop trains without the slightest recoil, that may be running at speeds of from 6 to 10 miles per hour. It consists of one, or a pair, of cast-iron cylinders mounted upon a concrete foundation, and the front castings project forward, carrying the piston rod or rods. Each rod is fitted at its outer end with a buffer head. The cylinder is entirely filled with water, and passages are provided so as to permit the water to flow from behind the piston to the front as the piston makes the home stroke. These openings are very much larger at the front than at the back. As the speed of the train is diminished, and the recoil of the piston takes place, a lesser area is provided for the water. For this reason an almost constant resistance is provided, and the incoming train is stopped without the sudden shock usually experienced. A relief valve is provided in the front casting which takes care of the equivalent amount of water displaced by the piston. The resetting of the piston is done automatically by means of a constant supply of water which is brought to the front part of the cylinder at a pressure of about 35 pounds to the square inch. This acts upon the area of the piston rod and immediately forces it into position again ready for the next train The illustration shows an 8-foot oil buffer. This is operated entirely by oil, which is forced, after having accomplished the action of the piston in checking the train, into the receptacle shown on the front of the forward casting, and may be used over and over again. In this case the return stroke of the piston is made through the use of compressed air which is available on the line.


Oil buffer to stop trains without shock.

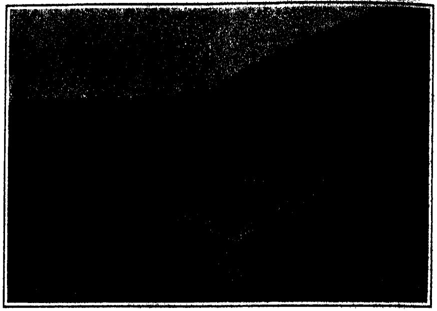
Building Dams on the Ice

THE Government engineers on the Upper Mississippi have found that by constructing the dams on the ice in the winter they can often build them in shallow places and across sand bars which are inaccessible to the barges and steamers in the summer months. The work also can be done much more cheaply. The willows and rock are hauled upon the ice by teams and unloaded at the place where the dam is to be constructed. The building crews follow the same method as is used in the summer months. A mattress of willows is made, loaded with rock, a second willow mat laid on top and so on until a dam of the proper height is constructed. When it is finished, the ice is cut away and the structure sinks to the river bed of its own weight The work on the ice has been progressing for three years all along the upper half of the river. Less has been accomplished this year than usual because of the thinness of the ice.


Building a dam on a frozen stream.

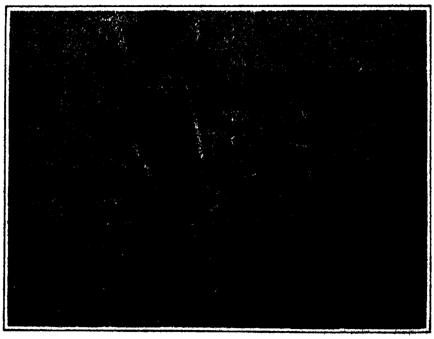
Primitive Bridge Engineering in Peru

THE curious suspension bridge shown in the accompanying [illegible] was built by the native Indians of Peru. It may be found across the mountains from Lima, in the Huancayo Valley, near Jauja, spanning the [illegible] River. Being a mountain stream, subject to sudden torrential floods, substantial towers have been built at each side, which provide secure anchorage for the cables and raise the floor of the bridge well above high water. The floor is hung from the cables by means of diagonal, as well as vertical lines, so as to prevent the bridge from swaying lengthwise. Side sway is prevented by guy lines running from the center of the bridge to each side of the towers. The water under the bridge is on its way to the Atlantic Ocean, *via* the Amazon River. A journey of over 3,000 miles lies before it.


Curious suspension bridge built by Peruvian Indians.

Obtaining Potable Water from the Muddy Colorado

AT the conception of the wonderful plan to divert the waters of the great Colorado River for the purpose of reclaiming the arid Colorado desert in California, no consideration was given the quality of the river's water. All that then concerned the adventurous engineers was to wet the thirsty land. Now that this has been accomplished and the famous Imperial Valley has blossomed into a land of immense agricultural activity, and half a dozen thriving towns have cropped up with an aggregate population of over 40,000, the problem of wetting the palates of these people has become a far more delicate undertaking than that of merely wetting the land. On its long winding course through the Grand Canyon country of Arizona the Colorado becomes supersaturated with a very fine silt, and this it carries on down into California and through the great Imperial Valley irrigation system, which covers an area of 350,000 acres. All the water used for drinking in the valley, both on the ranches and in the towns, has to be taken from the thick, chocolate fluid which runs through the big irrigating ditches.


Silt precipitated out of the drinking water of Brawley, California.

When the water arrives at Brawley in the extreme northern end of the valley, it has a molasses consistency and an invincible flavor. The 3,000 inhabitants of the town of Brawley consume 200,000 gallons of this water daily. In order to prepare the ditch water for drinking, the town has a municipal water plant. There are several large reservoirs or settling basins where the mud in the water is at first allowed to precipitate, the clear water afterward being pumped into an elevated storage tank from which it gravitates through the city mains.

The settling basins were made by inclosing an area of ground 200 feet square with battered earth walls to a height of 12 feet. The full head of the ditch water is run directly into this until the water is 6 or 7 feet deep, after which the supply is cut down to the actual amount consumed by the people daily. At the end of the settling basin, farthest from where the ditch water is received, a small raft is anchored. This supports an open-end, vertical pipe which is submerged about 6 inches below the surface of the water. This pipe is connected with a main from the pump house, and conveys only the surface water of the settling basin which is usually very clear.

The accompanying photograph illustrates what a great amount of mud is precipitated in these basins. The view shows the bottom of one of them after the water was drained off. The man is standing on the original floor of the basin. The 30-inch deposit was precipitated during a period of twelve months.

X-Ray Moving Pictures of the Digestive Tract

A New Way of Studying Diseases of the Stomach

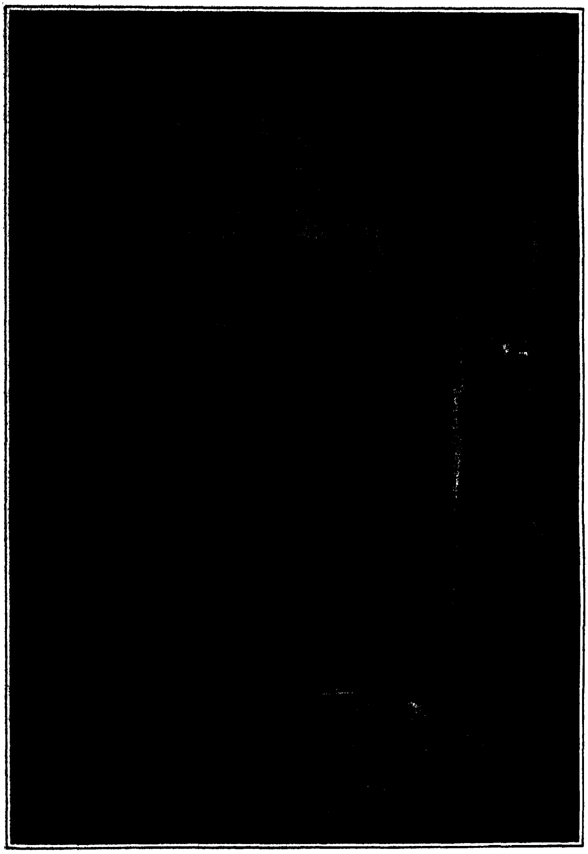
By Herbert T. Wade

AMONG the recent advances of medical science none has been more marked and conspicuous than progress in treating the various diseases of the digestive tract, particularly those of the stomach and the intestines. This has been made possible in great measure by modern methods of diagnosis in which quantitative and positive results have been secured in various ways, one and not the least of which has been the study of the digestive tract by means of the Roentgen rays. With the development of improved Roentgen ray tubes and a better understanding of methods for their use and application, it was realized that by filling the stomach or digestive tract with material opaque to these rays and making a radiograph or shadow picture of such a fluid cast in relation to the adjoining organs, the progress of digestion could be studied. This accordingly was done, and to-day in diseases of the stomach and intestines it is quite usual to secure a radiograph or plate on which is recorded such a fluid cast of the stomach and intestines filled with the opaque substance, and then make a Roentgenographic diagnosis.

This opacity is obtained by a mixture of bismuth or barium and buttermilk administered to the patient under examination, and the progress of this material, as it passes from the œsophagus into the stomach and is acted upon by the stomach and then passes out into the intestines, can be studied. Hitherto it has been feasible to take such a radiograph only at various stages of the process, although since the development of motion pictures and motion picture apparatus the desirability of Roentgenokinematographs, or X-ray moving pictures of the stomach, made to demonstrate and record not only the condition, but its actual movements or gastric motor phenomena, has been appreciated and attempts at its realisation made. As early as 1909 a series of successive Roentgenograms of the stomach were made by Doctors Kaestle, Rieder, and Rosenthal. Inasmuch as only thirteen of these pictures were made in 22 seconds, it was apparent that while a beginning had been made, with such slow speed true kinematography hardly could be attained, and the results were little more than an improvement on an ordinary series of Roentgenograms.

Recently, as the result of working on apparatus to make serial radiographs of the stomach and intestines, a special apparatus has been devised by a distinguished Roentgenologist, with which it is now possible to secure true moving pictures on an ordinary sensitized film at various stages of the digestive process at the rate of at least four exposures a second. Thus the churning effect in the stomach and the peristaltic or muscular action in the intestines by which the contents of the alimentary tract are advanced, after being duly acted upon, can be studied by means of motion pictures, which, when reproduced, graphically show by the movement of the silhouetted image the action that is taking place.

This new method has been made possible in large part by the new Coolidge Roentgen ray tube described in the SCIENTIFIC AMERICAN of February 21st, 1914, which secures in its operation greater stability and evenness of penetration as well as susceptibility to more accurate regulation, thus giving more even radiographs.



Apparatus for taking moving pictures of the stomach.

The apparatus *for* making the moving pictures consists of the usual lead-lined table in a dark booth with the Roentgen ray tube above in the usual position and the customary rotary transformer, or other devices, for its exciting, along with the special mechanism for securing the movement of the film and the periodic exposures. The patient is placed on the table, face downward, with the Roentgen ray tube directly above the stomach. There is a square opening in the table beneath, across which, through suitable guides, the film passes, being wound from one spool to another, as in an ordinary film camera. This film is eight inches in width and is supplied on spools which, as at present constructed, are capable of 25 or 50 exposures. Directly beneath the film is located an intensifying screen coated on its upper side with calcium tungstate, a fluorescent material that glows brilliantly when excited by the Roentgen rays striking its surface. Naturally, when the rays from the tube in their passage through the body encounter any body or substance opaque to them, as a bone, there will be a corresponding shadow on the fluorescent screen, and the variation in intensity of the shadows of different organs, or material, of course is the basis of the whole operation The actual effect of the intensifying screen is to emit actinic light under the influence of the Roentgen rays from the tube above The film itself is not acted upon directly by the Roentgen rays, but by the rays which are sent out from the fluorescent screen A second fluorescent screen, with its lower surface coated, located directly beneath the first, may be observed by the operator either directly or by means of an inclined mirror. In this way the position of the patient can be arranged so that the stomach can be centered on the film, and, at the same time, the action of the apparatus observed. The operator or the diagnostician can observe the process fluoroscopically and need not start the film in motion until the desired stage is reached.

The film has at its edges regular perforations to engage studs correspondingly placed on the circumference of sectors connected with the driving mechanism so that it may be moved regularly, but intermittently, across the opening where the shadow falls The apparatus is arranged so that six exposures a second may be made, and the exposure takes place automatically when a fresh section of the film is placed at the opening The mechanism operates by means of shafts and appropriate gearing, and there is arranged in connection an electric switch that works automatically in conjunction with the advance of the film, closing the circuit of the transformer supplying *the alternating* current, and lighting up the tube instantaneously as each fresh surface of the film is brought in position. Accordingly, there is a regular series of exposures of the shadows produced on fresh surfaces of the film and the phenomena occurring in the stomach and intestines can be observed and recorded. In this way, when the film is developed a series of pictures is obtained where the various exposures can be studied both individually and collectively in connection with one another, or they may be reduced by ordinary photographic methods for reproduction in the usual motion picture projection apparatus. The time of the passage of the film can be controlled by the operator and other adjustments made so that the exposures following each other in regular succession make possible a study of the peristaltic action, which is a regular and involuntary muscular contraction of the stomach, or intestines, with a period of from 15 to 20 seconds in the case of the stomach. Not only do these motion pictures enable some definite idea to be formed of the peristaltic action taking place in the stomach, but they promise in the future to put at the disposal of the diagnostician, or investigator, additional information regarding peristalis in the pylorus, or lower opening of the stomach, as well as in the upper part of the small intestine, or duodenum. Some twenty-five exposures can be made of a single antrum, and sharp and interesting pictures can be obtained.

The mechanical arrangement is indicated in the accompanying illustration, which shows the apparatus as arranged in a modern Roentgen ray laboratory. The operation is practically automatic. Once the patient is in position and the instrument adjusted, a fluoroscopic observation first is made visually, and the film can be rapidly unreeled and the exposures made. After development the diagnostician has a record of the condition of the gastro-duodenal tract, or the film may be reproduced reduced in size and made available in an ordinary motion picture projection apparatus, so that the record may be thrown upon a screen and the actual motion studied, synchronized to the original time of occurrence. Moving pictures have been applied to a greater or less extent in the study of disease and diagnosis, but this is believed to be the first satisfactory attempt at using them in connection with the Roentgen rays and with a special and efficient form of apparatus.

A Huge Dipper Dredge for the Panama Canal

UPON the cover of the present issue we show the huge dipper of one of the two large hydraulic dredges which have recently been completed for the Panama Canal The dipper can take up at a single scoop, 15 cubic yards, or say about 20 tons of material, and its huge proportions can be realized from the fact that it has held a group of thirty-four men, standing upon a platform built for the purpose when the photograph was taken.

The two dredges, which are known as "Gamboa" and "Paraiso," have been built at the yards of the Staten Island Shipbuilding Company. Each dredge displaces about 1,500 tons, and each, in addition to its 15-cubic yard bucket, has one other of 10 yards' capacity. It is expected that when in regular service the two dredges together can take out about 600,000 cubic yards of material per month.

The 15-cubic yard dippers have been built with massive manganese steel lips and dipper-door hinges of forged steel which are 6 by 10 inches in cross section. The dippers are 10 feet 9¼ inches in height from the bottom band to the upper edge of the lip. They are hung on a 3¼-inch, single-part, wire rope, hoisting cable. The dredges can dig to a depth of 50 feet below the surface of the water.

The dipper handle is 72 feet long, with top and bottom bars measuring 2 inches by 12 inches in cross section The weight of the dipper handle is 81,000 pounds.

The dipper boom is 62 feet long, weighs 113,000 pounds, and is of plate-girder construction. The pins for the sheaves on the boom are 11 inches in diameter, and the parts are larger than any built before for this purpose.

The main hoisting machinery consists of horizontal, twin-tandem, compound, condensing engines, with cylinders 16 and 28 inches in diameter by 24-inch stroke. The engines are compound geared to heavy spur gears about 12 feet in diameter. These gears are mounted on each end of a 16-inch main hoisting shaft which carries the cast steel drum.

There is an independent 12- by 16-inch engine of the link-reverse type for operating the swinging machine.

The spuds at the forward end of the dredge are of unusual size, being 4 feet square and 72 feet long. They are built with cast-steel diaphragms, 5 feet apart, and continuous 10-inch I-beams in the middle of each side plate for its full length. The maximum reaction on the spuds when the digging takes place over the side of the dredge is about 700,000 pounds The spuds are placed sufficiently far back from the front of the dredge to make possible a swing of 180 degrees.

The Current Supplement

THIS week's SUPPLEMENT brings the concluding instalment of P W. Bridgman's report on his researches on the properties of water and ice at high pressures—A working model for demonstrating the effects of vegetation as a check to erosion is illustrated and its construction is described.—W. P Dreaper writes of the research chemist in his relation to the textile industry. —A discussion on the sintering of iron ore, which took place at a recent meeting of the Engineers Society of Western Pennsylvania, is reported.—The erosion of canal bottoms by the action of boat propellers has caused much trouble. Prof. O. Flamm has devised means of preventing this, which are described—F. C. Perkins writes on electrically operated tools.- The third of Sir J. J. Thomson's lectures on Recent Discoveries in Physical Science appears in this issue.—H Guenther describes the Electro-cardiograph and Its Use—C. H. Townsend tells us how a school of five live porpoises was brought from Cape Hatteras to the New York Aquarium.—F. R. Moulton gives a popular exposition of the solution recently found by Karl F. Sundman for the classical problem of three bodies.

An Innovation in Ship Salvage

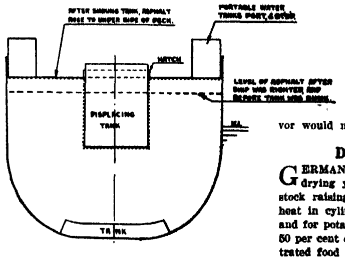
By Robert G. Skerrett

THE salvage of a steamer in grave peril because of a shifted cargo was accomplished a short while ago in a decidedly unique manner. The performance incidentally shows us the naval architect from an unusual angle and, incidentally, illustrates the advantage of technical training when applied elastically.

The craft in danger was a Danish freighter, the steamship "Berlin," bound from Trinidad, with a cargo of nearly 8,000 tons of crude asphalt, and on her way to New York city. The asphalt was from a new lake, and seemed even at the time of shipping to be somewhat more plastic than the usual run of that substance. It was stowed in the ship's regular cargo space, and aft the hold was divided longitudinally by a center-line bulkhead. However, there was no reason to expect trouble, and all went well until the vessel was some distance on her journey; but then the mischief began in earnest.

Suddenly from the northeast the "Berlin" encountered a heavy gale, and for days the wind blew fiercely, and the seas rose higher and higher as she nosed her way along through the Gulf Stream. She had to slacken speed, but with a sound hull and well-secured hatches there was no apparent cause for alarm. However, the warm waters of the Gulf Stream had been working unnoticed upon the cargo of asphalt, slowly heating it through and making it fluid. Somewhere north of Bermuda the "Berlin" was hit by three exceptionally heavy seas, one after the other, and without any warning the craft quickly heeled over to an angle of 21 degrees and staid there! The surging asphalt had broken the center-line bulkhead away from its fastenings top and bottom at the after end, and this had allowed the cargo to shift

The vessel seemed in imminent peril of turning turtle, and something had to be done, and done quickly. The engineer's force began the toilsome work of removing the coal from the listed bunkers, while the deck crew and the navigational officers went at the desperate task of trying to secure the upper edge of the ruptured bulkhead. By almost superhuman efforts, lasting well nigh for twenty-four hours, this was effected, but nothing could be done to catch and hold the lower end of the partition. After a fashion, the ship was righted somewhat, but there was still a menace in that loose bottom of the bulkhead.


AFTER SINKING TANK, ASPHALT ROSE TO UNDER SIDE OF DECK.
PORTABLE WATER TANKS PORT & STBD
HATCH
LEVEL OF ASPHALT AFTER SHIP WAS RIGHTED AND BEFORE TANK WAS SUNK.
DISPLACING TANK
W.L.
TANK

SECT AT AFT. HOLD

As the ship rolled toward the side where the bulkhead plating should have been fastened, the partition gave somewhat like a pump leather and allowed the asphalt to surge through the opening toward the listed side. Again, when the ship rolled oppositely, the plating closed the breach and kept the asphalt from flowing back again. Thus, the motions of the vessel and the flexing of the bulkhead acted just like a pump, and raised the level of the threatening fluid four feet higher on one side than on the other. Fortunately, the deck and the hatches held, although the ship had a serious list, and, after an exhausting struggle, the "Berlin" made harbor at Cape Lookout, North Carolina. Her further relief had then to come from regular salvors.

A New York salvage concern that has done some rather remarkable work was asked to bid upon the job of sending a relief vessel to take off a thousand tons of the "Berlin's" cargo, and, together with the Danish craft, to bring both vessels to New York. The asphalt was then far from fluid enough to be pumped out, and to remove by digging would have been a long and a very toilsome, not to say expensive, undertaking. The salvors wanted an easier solution of the pending problem, and just at this stage Mr. R. H. M. Robinson, lately a naval constructor in the United States Navy, was called into consultation. It did not take Mr. Robinson long to figure out that two wooden tanks, one on each side of the upper deck, 5 feet wide and 100 feet long, would hold double the amount of water ballast necessary to trim the ship to an even keel against the listing moment of the [illegible] [illegible]. [illegible] [illegible] surging, each tank was subdivided [illegible] [illegible] compartments, and 131 tons of water were [illegible] [illegible] [illegible] the craft when this ballast was put in the [illegible] [illegible] the [illegible] side. The idle tank was held in reserve [illegible] [illegible] any emergency should the asphaltum shift to the opposite side en route to New York.

But this was not the entire solution of the difficulty, and to Mr. C. F. M. Jack, another naval architect of New York, credit is due for the clever [illegible] by which the cargo was made to fill the entire hold up to the under side of the deck, and was thus held in place so that it would have no chance to shift again. In one of the big hatches a tank was fitted and loaded until, in sinking, it displaced the asphalt. A crude stuffing box was made out of the cargo hatch coaming, and the displacing tank thus became a weighted hydraulic plunger free to move up and down and to absorb strains that would otherwise have been transmitted to the covering deck.

According to the previous estimates, and counting upon removing a thousand tons of the cargo, it was clear that many days would have been required to get the ship on an even keel again and ready to resume her run northward. But even so, with that work done, there would have been no certainty that the remaining cargo might not have caused more trouble. By the adopted method it took just three days to build the tanks of wood and to fit them in readiness for service The tanks were made of heavy planking lined with tarred paper, and the displacing tank was loaded with bags of sand, sand being a readily obtained material of nature's providing down on the Carolina coast. From the time the salvors started southward from New York until the "Berlin" reached the metropolis under her own steam was a matter of just eleven days.

But for the naval architect's few minutes of figuring, by which he determined how much deck weight moved laterally would be needed to effect the change of trim desired, many days would have been lost in following the usual procedure in digging out that difficult cargo. Time was saved, money was saved, and a unique remedy was evolved, which may have many practical advantages in meeting kindred conditions in the future. The ordinary salvor would not have thought of this expedient.

Dried Yeast as a Cattle Food

GERMAN breweries are going into the question of drying yeast with a view to producing food for stock raising. Such yeast is dried at a rather high heat in cylinders, such as are used for milk powder and for potato drying. The dried yeast contains about 50 per cent of albuminoid matters and forms a concentrated food which can be used to good advantage for most stock when mixed with other foods, and is relished by cows, sheep and horses. With cows, the percentage of butter in the milk is increased, and for horses it is said that half the grain is economically replaced by mixed dried potatoes and dry yeast. Within three years the number of yeast-drying plants increased from 5 to 26, counting 11 in Germany. It is now introduced for human food, but in this case the yeast is freed as much as possible from the bitter principle due to the hop. Such prepared food is said to be easily digested and assimilated, and Völtz and Baudrexel showed that its value is three times its weight of moderately fat meat. It not only serves for food, but acts very favorably on nutrition owing to the lecithin contained in the proportion of about 2 per cent. According to Hayduck the product, even though it costs $0.60 per pound, costs less than meat for equal food value. It is probable that the price will be lowered when it is produced on a large scale, and no doubt it will be frequently employed in the food industries as a very economical source of albuminoid substances.

Uncorking a Bottle

IT often happens that in attempting to uncork a bottle, the stopper is forced into the bottle instead, and it thus floats on the liquid. This would perhaps not be a drawback were it not that each time the bottle is to be emptied the cork comes to the neck and causes an obstruction, preventing the flow of the liquid. This can be avoided very readily, and all that is needed is to bend a piece of stiff iron wire in a long U-shape, properly fitting it in the neck of the bottle so that the loop portion projects somewhat below the neck. Upon overturning the bottle, the wire loop prevents the cork from reaching the neck to obstruct it.

Gamma Rays Produced by Roentgen Tube

ACCORDING to a special cable dispatch to the SCIENTIFIC AMERICAN, Director Dessauer of the Veifa X-ray Tube Works, Frankfurt a. M., has succeeded in producing highly penetrating rays similar to the gamma rays of radium, by means of [illegible] Roentgen tubes.

[illegible]

[illegible] statements [illegible]. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Urgent Need for an Increase of Our Navy

To the Editor of the SCIENTIFIC AMERICAN:

In the admirable series of articles which you are publishing in the SCIENTIFIC AMERICAN on the "Problems of the Navy" you published two tables, one of personnel of the three leading navies, and the other naval tonnage, built and building, 1912. I would request that you publish the following tables brought up to January 1st, 1914, for the five leading naval powers. The joker in the naval tonnage, built and building, is the large loans which France, Japan, and Germany are making for new construction, and which do not appear in the ordinary naval estimates, thereby lulling us to sleep under a false apprehension. These tables are not attractive, but they will bear careful study by any one who is really interested, and are very illuminating. The one thing we all fail to grasp is that the pre-dreadnought battleships and armored cruisers must soon be passed out and their place taken by dreadnoughts. The proposition to convert the only five scout cruisers we have, viz., the "Chester," "Salem," "Birmingham," "Minneapolis," and "Columbia" into fast merchant vessels for commercial purposes is fantastic, unless we recognise the necessity for building up-to-date scout cruisers with 4 inches of side armor and 28 knots speed, similar to those now building abroad. We are woefully lacking in torpedo boat destroyers, but the type we are now turning out, if made a little smaller and cheaper, would be ideal. The only reason the tonnage has been increased is that in the absence of scout cruisers, of which we have practically none, no one needs to be a prophet to see that torpedo boat destroyers will, in case of war, be used as scouts, for which they were not intended, and we will be without destroyers for the protection of the fleet.

The tables are as follows:

TABLE I.

NAVAL TONNAGE BUILT AND BUILDING JANUARY 1, 1914.

Item.	Great Britain.	Germany.	United States	France.	Japan
(1) Naval appropriation	$385,213,496	$112,037,576	$140,736,526	$122,493,753	$74,383,783
(2) Amount voted to new construction	77,862,162	53,240,546	35,825,695	63,655,515	26,278,631
(3) Percentage devoted to new construction	33%	47%	25%	44%	54%
(4) Resultant new construction in tons	538,580	284,870	161,842	230,264	204,900
(5) Total tons already built	2,062,711	943,338	760,002	645,891	497,199
(6) Total of (4) and (5) tonnage built and building	2,601,291	1,228,208	921,844	876,155	702,099
(7) Dreadnoughts and battle cruisers built	27	17	*10	2	3
(8) Dreadnoughts and battle cruisers building	15	9	4	9	7
(9) Capital ships, new (dreadnoughts)	42	26	14	11	10
(10) Pre-dreadnought battleships on hand	40	20	24	18	13
(11) Pre-dreadnought armored cruisers on hand	34	9	11	20	13
(12) Unarmored cruisers built and building	82	44	14	10	14
(13) Torpedo boat destroyers built and building	187	142	62	86	56
(14) Submarines built and building	94	36	51	93	15
(15) Coal colliers	1	2	11	1 (small)	0
(16) Coal and oil colliers, or oil only	12 (small)	0	13 (large)	1 (small)	0
(17) Supply ships	0	0	5	1 (small)	0
(18) Ammunition ships	0	0	1	0	0
(19) Repair ships	3	0	2	1	0
(20) Hospital ships	2	0	2	0	2
(21) Transports	0	0	5	1 (small)	0
(22) Mining ships	7	4	1	2	1

* This includes the "Michigan" and "South Carolina" as dreadnoughts.

TABLE II.

PERSONNEL OF NAVIES, JANUARY, 1914.

	Great Britain.	Germany.	United States	France.	Japan
(1) Total number of flag officers allowed	96	40	18	45	67
(2) Total number of captains and commanders	683	356	207	360	259
(3) Total other line and engineer officers	3,835	2,852	1,549	2,022	2,831
(4) Total warrant officers	2,693	2,696	867	2,445	1,553
(5) Total line, engineer and warrant officers	7,394	5,934	2,641	4,872	4,710
(6) Total enlisted men	115,208	60,920	49,854	60,505	43,847
(7) Ratio of enlisted men to line, engineer and warrant officers	1 to 16	1 to 10	1 to 19	1 to 12	1 to 9
(8) Marine officers	471	169	345		
(9) Enlisted men (marines)	21,083	5,507	9,921		
(10) Total medical officers	593	322	314	394	373
(11) Total pay officers	655	267	231	219	362
(12) Total naval constructors	118	159	75	175	143
(13) Total chaplains	151	28	24		
(14) Total officers and men	145,563	73,396	63,413	63,859	49,435

COMMENTS ON THE ABOVE TABLES.

Items (1), (2), and (3).

France has raised a loan of eighty-one million dollars for new construction, of which $28,002,685 has been added to the regular annual appropriation of ninety-four millions for the year 1914. Japan has also raised a loan, or provided by taxation, for $78,337,869 to be added to the regular annual appropriation for 1911 to 1917. Since 1909 the German government has raised annual loans to meet the extraordinary extension of naval expansion amounting now to about $220,000,000. Not only is the present generation not finding this money, but also the interest on the loans, and the annuities for the repayment of these loans do not appear in the naval estimates in any form. Consequently the actual expenditures of Germany are far higher than [illegible] in the estimates here given. Therefore, in the above table, Great Britain and the United States are the only governments which are not contracting loans for naval expansion. Germany has a fixed programme whereby in 1921 she is to have a fleet of 41 new dreadnought battleships, 20 armored cruisers, 40 light cruisers, 144 destroyers, and 72 submarines. The fixed charges which each country has to meet each year to merely maintain what navy they have without providing for new construction is about—Great Britain, 158 million; United States, 105 million; France, 66 million; Germany, 52 million; and Japan, 48 million. In the three last-named countries they have "conscription" and the pay is very, very small.

Items (4) to (15).

Items (4), tons of new construction, and (8), dreadnoughts building, show that the United States is on the toboggan slide to fourth or fifth place. The 25 per cent of item (3) shows this also. It is idle to fall back on items (10) and (11) of old ships which we had before the era of the all-big-gun ships. People with automobiles of the vintage of 1900 are living on the side streets. Other countries about crushed by taxation are raising taxes to catch up and get in the game. We alone are hypnotized by political oratory and self-complacent bumptiousness. Needed, immediately, a Council of National Defense, and a loan of $100,000,000 to increase the number of officers and men, build 10 battleships, 20 light cruisers for scouts, 36 torpedo boat destroyers, and 25 submarines.

Items (15) to (22).

It will surprise many people to learn that our Navy is the only one which has developed a fleet of auxiliary ships of special design for supply and service of the fleets in time of peace, ready for war. Other navies rely on chartering in time of peace, and buying and chartering in time of war the necessary merchant ships to carry coal, oil, provisions, ammunition, marines, and the sick.

Our new repair ships are superb, but we are lacking hospital ships. We have been quietly accumulating these ships, and may now stop, provided we build colliers of the same type for the service of the Panama Canal, or build other ships to run as merchant vessels in time of peace, as proposed by Senator Weeks for our now inadequate scout cruisers (we only have about five in all). The questions of any further auxiliaries, except two new hospital ships, should be taken up as a passenger and freight service in time of peace. The two hospital ships owned by Japan are regularly run between Nagasaki and Shanghai in time of peace as passenger vessels.

The mine ships of foreign navies are necessary because in all other navies than our own the coast and harbor defense is under the navy. With us it is under the Army. The one mine ship we have in the Navy is for the protection of the fleet. NAVY.

U. S. S. "Michigan," *en route* Vera Cruz, Mexico, April 21, 1914.

Mobilization and a Naval Reserve

To the Editor of the SCIENTIFIC AMERICAN:

The article, No. VIII, "Mobilization and a National Naval Reserve," in the April 18th issue of the SCIENTIFIC AMERICAN, is one of the ablest articles dealing with our great national need which has ever been published. It should be read and studied by every member of our Congress, and by every constituent.

That nation which can best guarantee its own peace and protection is the one best prepared for war. The cost of preparedness is but a fraction of the cost of war to a nation unprepared.

Do not our people realize that all the other great nations are quietly and grimly preparing for war in spite of peace conferences

Your article was patriotic, highly commendable, and unless we awake, will prove equally prophetic.

Daytona, Florida. L. M. DRAKE.

The Perils of Electricity

To the Editor of the SCIENTIFIC AMERICAN

I am sending you the following excerpt from the editorial columns of a local paper, thinking that you might be interested in hearing of the great peril in which the world is placed:

"This matter of handling electricity is getting to be a dangerous thing. At Madrid, Spain, Senor Igelsias recently 'lighted and extinguished at will fifteen electric bulbs at a distance of 600 yards.' It is also claimed that in February William Marconi lighted an electric bulb at a distance of six miles, by a wireless current. Electricity to do this must be very powerful In the hands of a villain, electricity may yet be so used as to set whole cities on fire, kill individuals at will without being liable to even the least suspicion And if individuals can be slaughtered, why not entire armies and whole communities? One cannot tell where all this will end."

After much careful consideration the only remedy which I can see is that we who have enemies who are electrically inclined refrain from carrying around with us in our pockets receiving plants strung up in series with a pound of dynamite. I realize that this would be a great sacrifice, and yet, for the sake of the world, we should do it. OSWALD C. BREWSTER.

Boulder, Colo.

Centrifugal Force Versus Screw Lift

To the Editor of the SCIENTIFIC AMERICAN:

Every little while someone brings out an invention in which a propeller is to be run in a hood or tube, although it has been well established that better results and higher efficiency can be attained by running the propellers in the open. Only last year one of our most prominent aeroplane builders was experimenting with propellers in his research laboratory, with the aid of a wind trunk; and he was quite undecided whether to run inclosed propellers or to place them in the full-sized wind passage.

Several years ago the writer was experimenting with centrifugal pumps, and while at work with his first model had an experience so unexpected, and that was so baffling as to fix it in his mind as a lesson well worth remembering. He would like to pass it along, and trusts that it may not prove unprofitable reading to you.

The pump model was exceedingly simple, being a piece of shafting about 2 inches in diameter by 15 inches long, deeply threaded with two opposed screws similar in appearance to the screws of a meat chopper. The screws were equal in length and pitch and were right and left hand. A space was cut out in the central part of the shaft, the intention being to have the screws pump toward each other, thus equalizing the end thrust. This opposed screw shaft was run in a well fitting hard brass tube that had an outlet delivery at its center and adjacent to the space in the shaft between screws.

You can imagine my surprise when I found that the submerged twin screw could be driven at a very high rate of speed; probably it was turning at from 3,000 to 4,000 revolutions per minute, and yet the water was practically at a standstill, surging slowly up and down about three quarters of an inch in height in the outlet tube.

After considerable study I reached the conclusion that the screw lift was nearly balanced by the centrifugal force, and its reflex action against the inflowing water. No doubt viscosity and adhesion played an important part, yet for want of time I was unable to experiment in that line My defeat, however, pointed the way to balanced and opposed screws or scrolls that operate in parallel planes of centrifugal action.

Later experiments would indicate that any centrifugal pump could be reversed in rotation, and running in that manner would pump a little; this proves to my mind that centrifugal force, when aided by adhesion and viscosity, is greater than screw lift at the same radius and speed. WALTER A. SIMOND.

Franklin, N. H.

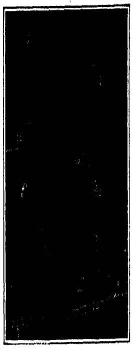
Making the Navy's New 14-inch Guns

By Louis E. Browne

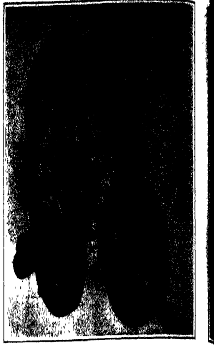
ON Sunday, April 26th, there sailed to Mexican waters the new dreadnought "New York," which was recently completed at the New York navy yard. She will be followed in a few days by the sister ship "Texas." The delivery of these ships to the Government will mark an epoch in naval construction, for they will be the first ships to mount 14-inch guns These ships will be by far the most heavily armed in the world The ten 14-inch rifles are arranged in pairs in five turrets, all of which are upon the ships' center lines This design, adopted by the Navy several years ago, enables every gun in the main battery to fire on either broadside

Experiments with the 14-inch rifle began in 1900, and it was adopted by the United States Navy as its standard big gun late in 1906 Like the 12-inch rifle, the new guns for the dreadnoughts now building are of the built-up type, consisting of the tube, or lining, jacket and several hoops No single casting could withstand the enormous stresses resulting from a modern firing charge The guns are built in parts and shrunk together to give vastly greater strength

The Navy requires steel of the highest grade of perfection for the new guns An increase in the principal properties of malleability, ductility, hardness, toughness, tensile strength, and elasticity was desired While not greatly superior to the steel used in the 12-inch guns, the metal which goes into the new 14-inch rifles is slightly superior A steel containing something more than three and one fifth per cent of nickel was selected. The Bureau of Ordnance requires that all steel gun castings be made by the Whitworth and open hearth method The molten metal is poured into a special mold and compressed by hydraulic action applied to rams A pressure of more than 6 tons per square inch is used to get rid of blow-holes and to obtain a metal of high density This method also prevents "piping" and segregation of the various constituents, such as sulphur, phosphorus, and manganese

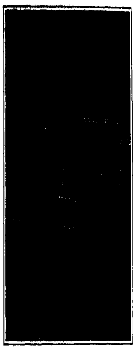


Lowering the heated chase hoop over the liner, upon which it will shrink in cooling.



Three tools for removing burrs and polishing the rifling of the gun.

draulic press enters largely into the work of manufacturing the 14-inch gun.



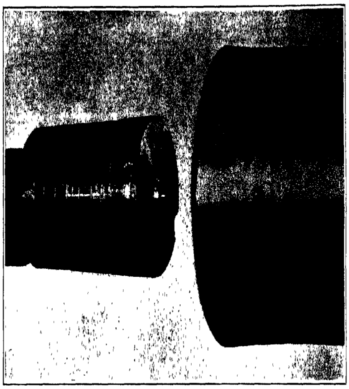
The chase hoop shrunk on and held in place during cooling by 500-ton jack.

The ingots are carefully reheated and forged to about one half of their original size This operation, according to naval requirements is performed after the casting has been rough drilled through its longitudinal axis. After forging the castings are gradually re-heated and annealed They are again heated, treated to an oil bath, and re-annealed The castings are now ready for delivery to the Naval Gun Factory in Washington When received there the castings are given exhaustive tests, and if found wanting, returned to the foundry as scrap

As the forgings are rough-drilled in the private foundry they are ready for rough-turning when received at the gun factory. They are carried to the lathes by traveling cranes The breech end is gripped in several large jaws on the face plate and the muzzle end is gripped by a "pot center," a large iron ring having several arms screwing radially through it Thus the forgings are held upon live centers.

The operation of turning is comparatively simple Often as many as four or five tools are used at the same time, requiring two or three carriages Tools 1½ inches wide are used for finishing, and there is no difficulty in keeping the measurements within 0.001 of an inch

Boring requires much greater care than turning; for the action of the drill, or cutting tool, cannot be observed. Three cuts are usually required to bore the tube and hoops. For the first cut a hog bit, a half cylinder of iron with a steel tool protruding from its end, is used. The other cuts are made with a packed bit, a wooden cylinder with an ordinary cutting tool. The wooden cylinder is slightly larger than the hole cut by the tool This insures an even, true cut When bored, the tubes, jackets, and hoops are ready for assembling, that is, shrinking together



The boring tool with which the inner tube of the gun is bored out to the exact final dimensions before rifling.

The tube, which is slightly tapered to render easier its extraction after it has been worn out by firing, is lowered into the shrinking pit, breech-end up. It is connected with water mains and cold water is allowed to circulate within it This keeps its temperature normal and assists in cooling the jacket. The jacket is next lowered into the hot-air furnace, which is a vertical cylinder of gigantic proportions made of fire brick and asbestos It absorbs heat from hot air, which has been passed over petroleum burners in pipes. The hot air enters the furnace at the bottom, circulates about the casting and is drawn out at the top to be reheated.

Because of the immense size of the jacket it takes more than thirty-six hours to raise the temperature of the metal to 700 deg. Fahr., which is the highest temperature to which this metal can be raised without changing its form in any way. The jacket is taken from the furnace by the crane and carried above the shrinking pit, where it is heat-tested. Metal strips, which have melting points between 400 and 600 deg. Fahr., are passed over every foot of the jacket. These are extremely efficient thermometers. Guided by men with asbestos gloves and huge tongs, the jacket is lowered over the lining, or tube, to the required position. A cold water spray is directed against the points in the jacket where it should first cool. The remainder of the jacket cools unassisted. Should the jacket jam, it is immediately hoisted off, allowed to cool, the abrasions filed off and another trial made. When cool, the tube and the jacket, which have been firmly shrunk together, are hoisted out of the pit and carefully measured. The tube is gaged to determine how much compression has resulted from the operation.

Why guns are built in parts and shrunk together is easily explained. Steel is elastic. It will withstand a certain pressure, stretch so much, and return to its normal condition When the pressure is too great it stretches beyond its limit of elasticity and breaks. If this same steel can be compressed from without it will then require a force equal to the limit of elasticity of the steel, plus the value of the pressure causing compression of the steel, to break or permanently strain the steel.

In shrinking the tube, the jacket and the hoops together this compression is attained. Thus, to burst a modern gun it requires a force equal to the strength of the steel plus the compression.

In each case the outer hoop is heated and slipped over the inner one In the operation described above the inner diameter of the 14-inch jacket when cold is always a little smaller than the outside diameter of the tube over which it is shrunk. The jacket is expanded by heat. It slips over the tube. When it cools it contracts and compresses the tube, making it slightly smaller than it was before The amount by which the diameter is decreased is called the compression. The jacket is also slightly enlarged by the process, but not beyond its limit of elasticity, so that it aways retains the tendency to return to its normal position.

It was found, especially in making the large gun, that it was much easier to bore the jacket and hoops first and to adjust the others parts to them than it was to try and fit the great inside boring to certain castings. The jacket fits over the breech half of the gun. The chase hoop fits over the muzzle half. By the same process the chase hoop is shrunk on next to the jacket. A locking hoop is next shrunk on over the joint of the jacket and chase hoops. Five smaller hoops are shrunk on the 14-inch gun before it is ready for finishing.

The gun is carefully drilled or bored and turned in the great lathes. The muzzle is finished by hand. The screw box is made in a collar. Formerly it was made in a jacket. This renders possible a change of screw box should the threads of the breech become worn. The collar fits tightly against the jacket and tube. This prevents the tube from moving to the rear.

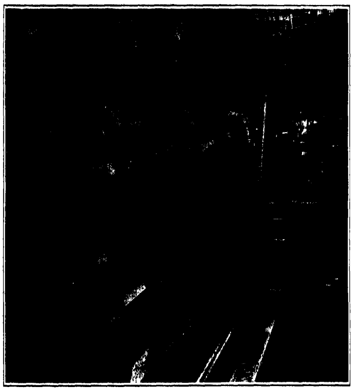
Rifling gives the shell a rotary motion about its axis, which tends to keep its axis in the true line of flight. Rotation of the obtained as the result of a band of copper, firmly fixed to ll, being forced into the grooves as soon as the shell starts the gun. The grooves are spiral cuts in the lining of the n the 14-inch gun the grooves are uniform in twist. They to a depth of about one twentieth of an inch, and are someder near the muzzle than at the breech. The grooves e a circle in about twenty-four calibers. In the 14- s this gives the shell one twist in 28 feet. Thus, out its trip through the air the shell revolves once 28 feet covered. The groove is cut from the muzzle a cutting machine similar to a lathe.

ore is "lapped" with three sets of tools as shown in ompanying photograph. Emery and oil are used Lapping removes burrs caused by grooving.

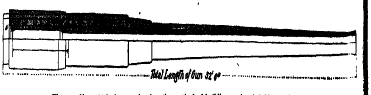
provement has been made in the manner of fitting reech mechanism, which is simply two inches larger out than the mechanism used on the 12-inch guns. e in the new 14-inch gun is screwed on and is cona part of the gun. A shoulder prevents a forward nt of the yoke, and steel rings prevent it from going ar

un is then declared to be finished It is fitted to ions and slide and carefully balanced The sights ched to the slide, or carriage. The gun and care then shipped to Indian Head, Md., for a test of s with excess charges of powder. It is returned to factory, smoothed over and coated with oil and d, and stored for future use.

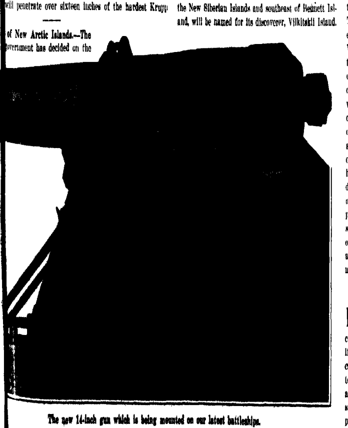
ing the "New York" and "Texas" will come the " and "Oklahoma." These ships are nearing com- They will carry ten 14-inch guns in four turrets. nsylvania," authorized in 1912, and "Battleship 39," authorized, will carry twelve 14-inch guns in four This, of course, means three guns in each turret. re some of the characteristics of the 14-inch gun. calibers in length, that is 52 feet 6 inches. It 4 tons, has a muzzle velocity of 2,600 feet per second, and ll weighing 1,400 pounds. At a distance of 10,000 yards will penetrate over sixteen inches of the hardest Krupp



The turning and boring of the gun is done in large lathes constructed especially for this work.



The new Navy 14-inch gun, showing the method of building up by shrinking on hoops.



The new 14-inch gun which is being mounted on our latest battleships.

Piece is 52 feet 6 inches long; weighs 63.4 tons; fires a 1,400-pound shell with a muzzle velocity of 2,600 feet per second and a muzzle energy of 65,606 foot-tons.

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of New Arctic Islands.—The overnment has decided on the following names for the three islands north of Siberia discovered by Lieut. Vilkitskii (Wilkitsky) last summer. The large island north of Cape Chelyuskin, the coast of which was followed for a distance of about 200 miles, is to be called Emperor Nicholas Land; the smaller island, lying south of this, Czarevitch Alexis Island; and the small island discovered northeast of the New Siberian Islands and southeast of Bennett Island, will be named for its discoverer, Vilkitskii Island.

The U. S. Government as a Map Publisher

THE Superintendent of Documents has just published a revised edition of his Price List 53, "Maps Published by the United States Government." The great number and varied character of the maps listed in this pamphlet is the more surprising in view of the fact that it is really far from being a complete list of the maps published by the Government, but merely an enumeration of those offered for sale by the Superintendent of Documents The four great Government map publishers—the Geological Survey, Coast and Geodetic Survey, Hydrographic Office, and Post Office Department—sell their own maps, and are not represented in this pamphlet, and the same is true of a few other map-publishing offices, such as the Mississippi River Commission Americans who are fond of patriotic superlatives may rest assured that the United States Government is, collectively, the greatest map-publishing institution in the world What is much more important, the maps issued by our Government compare favorably in workmanship with the best cartographic productions of foreign countries—a fact that helps to make amends for the disgracefully crude and inaccurate maps contained in most of the American-made atlases offered for sale in our book-shops.

How Long Has an Animal Been Dead?

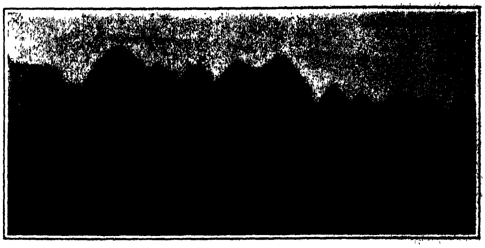
THE time of an animal's death and thus the age of meat is determined by E Lenk by a new method, which consists in noticing the variations in weight undergone by placing animals' flesh in water or saline solution, and he thus observes modifications which the microscope or chemical methods fail to reveal. Examining the weight of a piece of fresh muscle, he finds a continuous increase of weight up to 30 hours after the animal's death. After this the muscle loses not only the water it had absorbed, but also a part of its own The progress of the muscle's swelling is related to the establishment or relaxation of the cadaveric rigidity When the muscle takes up water, this is due to absorption of water by the biocolloids, caused by production of lactic acid after death As this lactic acid becomes concentrated in the muscle, the albuminoid substances which become reduced to the state of flakes, become incapable of retaining the water absorbed The process of unswelling which follows corresponds to the relaxation of cadaveric rigidity He finds that the nature of the liquid used, and also osmotic pressure, enter in here, and it is known that lactic acid production after death makes a complete change in osmosis While the osmotic pressure of living muscle corresponds to a 1 per cent common salt solution, it requires a 30 per cent solution to compensate the osmotic pressure of meat of a certain age, such as is found in commerce Such a method has an interest for food analysis and legal medicine.

Cover Your Bottles With Leather

IN carrying a small bottle, for instance, of medicine on a voyage, it is an excellent plan to make a leather covering for it, and this is easily done In this way if the bottle breaks there is no danger from wounds caused by the glass, and the cover acts as a good protector For a square section bottle, trace the profile on a piece of leather four times side by side, and add the small square representing the bottom, to one of the profiles. Cutting out with the scissors, this makes only one seam at the end to be sewed up, also the parts at the neck of the bottle, and the bottom piece.

Where People Live in Hives

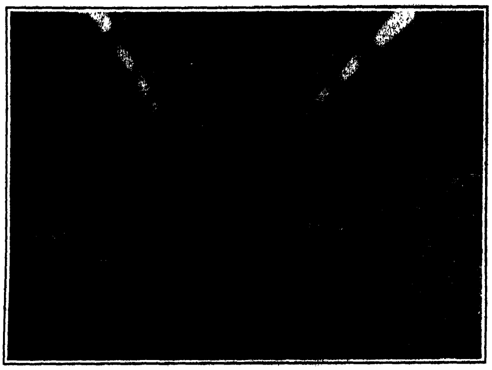
IN Mesopotamia the traveler sees a quaint form of dwelling, built of mud bricks in the form of a hive. Villages and whole towns in this peculiar form of architecture are met with. As the country is destitute of trees from which to hew rafters, and also devoid, in parts, of stone, the natives build their habitations of sun-dried mud bricks with high steep domes, similar in shape to a bee-hive. Our illustration depicts one of these bee-hive villages not far from Aleppo, on the route of the famous Bagdad Railway. Each home consists of several of these hives standing near together, and surrounded by a wall of similar material. One or more are used to live in, another for the animals, and still another serves as a granary, and so on, according to the possessions of the proprietor. One dwelling is seen without its outer covering of clay. The smaller conical piles are of dried manure, used for fuel.



Mesolmeleh, a "bee-hive" village, near Aleppo, Syria.

Safety Campaign Car

SENDING a "Safety First" campaign car over its entire lines, and instructing its employees in safeguarding not only their own lives, but the lives of the public as well, is the latest development in the campaign of safety waged by the New York Central Railway. This is the first instance of such an exhibit traveling in a railroad car, and the instruction given through its equipment is doing much to decrease accidents. The car has been in operation but a few months, and already records show that there have been thirty-five fewer employees killed while on duty than for the same period of last year. This, of course, covers the entire system of the road. As an educational feature, the car is especially interesting to the general public as well as to the employees of the railroad. Its lessons are all strongly impressed upon the minds of the onlookers, by a system of "Seeing is believing." Models of all machinery used by the company are shown, together with the right and wrong method of guarding dangerous parts. Photographs on one side of the car picture to the audience unsafe practices of railroad employees. The trespass danger is very forcibly shown by a number of photographs illustrating how persons risk their lives needlessly walking on railroad property. Above these pictures is a statement calling attention to the fact that no less than ten thousand such danger-defying people are killed on the roads of this country each year. One model of especial interest is that of the modern freight car with all its up-to-date mechanism and safety appliances. Attached to the exhibit car is a coach to be used as the lecture room, and this is equipped with a stereopticon by means of which illustrated lectures on safety are given to the men employed by the road.



Railroad car fitted up as a traveling exhibit of safety appliances.

A Giant of the Foundry

THE casting shown in the illustration is the low-pressure cylinder of a Corliss engine having a stroke of 5 feet and bore of 7 feet 2 inches. It is a single piece of iron, weighing 90,000 pounds. Some idea of its size can be obtained from the fact that a man of more than average height standing within the cylinder can just reach the top with the tips of his fingers, while the four shop helpers can easily crawl through the openings for its great valves. Those who are at all familiar with the trials that beset the molder can form some idea of the extreme difficulty in making a casting of such dimensions and weight. The steam ports indicated by the position of the right hand of the man to the extreme left of the illustration, required the most elaborate coring, and this particular piece of work was a most difficult operation.

Low-pressure cylinder of a Corliss engine—a 90,000-pound casting.

The [illegible]

IN a recent number of [illegible] upon the invention of [illegible] the utilization of translucent [illegible] of opal or ground glass for [illegible] name "marble light" does not [illegible] for we do not speak of a [illegible]. However, the [illegible] a better designation [illegible] not more complicated can [illegible] be found.

That marble in thin plates, particularly the colored varieties of marble, render it possible to obtain very beautiful effects has long been known, but the difficulty of producing thin marble sheets at a low price has made it impossible to utilise the discovery in a practical way. Latterly, a Hamburg engineer, W. Engel, has succeeded in making marble plates varying in thickness from 8 to 20 millimeters by means of a special grinding and saturating process. It is said that his marble plates permit a greater amount of light to pass through than ordinary frosted glass plates.

The marble plates are first ground down on both sides, and afterward saturated in oils of various kinds at high pressures and temperatures. Very beautiful effects are produced which it is said can hardly be obtained with colored glass.

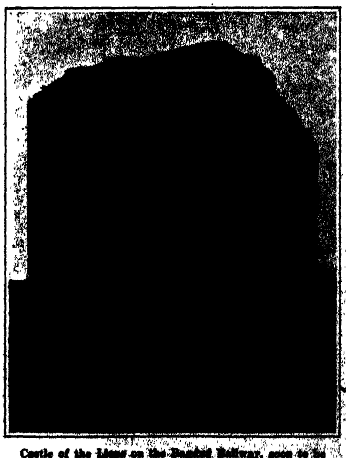
But pure white marble plates are also made, which, it seems likely, will compete successfully with opal glass. Less light is absorbed than with glass, and the color obtained is more agreeable. Most opal glass imparts to the light a greenish hue, the tint of the light which passes through the marble plate is rather a reddish violet, and, therefore, much more agreeable.

Caprifying Smyrna Figs

THE annual report of the Bureau of Plant Industry announces an important discovery in connection with the cultivation of Smyrna figs; viz., that the caprifigs may be carried over winter indoors if packed in boxes alternating with layers of sand. This discovery assures to the fig grower a supply of caprifigs regardless of the severity of the winter.

Old Crusader Tower to Be Demolished

JUST outside the Syrian port of Tripoli, lying alongside the railway track, is a famous old fort, known as the Tower of the Lions, from the tradition that it was built by Richard the Lion-Hearted, of England. As a matter of fact, it is one of six such forts built by the Crusaders to protect the coast, only one other of which exists, and which is in a poor condition. Now the Tower of Lions is to be demolished to make room for the railway, much to the discomfiture of archæologists who would like to see this old tower preserved as a relic of antiquity.



Castle of the Lions on the Bagdad Railway, soon to be torn down.

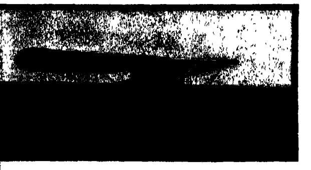
Switzerland has four coöperative associations for the growing and marketing of forest products.

New European Designs in Aeroplanes

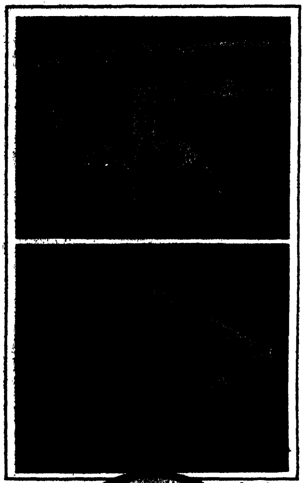
The Short Folding-Wing Sea-Plane; Three New French Flying Machines

By European Correspondents of the SCIENTIFIC AMERICAN

The Ruby torpedo.



The new "total vision" Blériot monoplane.



The Short sea-plane with folding wings.

The Short sea-plane. Its wings folded.

The F. B. A. flying boat.

Three New French Aeroplanes

By John Jay Ide (Paris)

The Ruby Torpedo

OVER two years ago there appeared in France a machine which sounded a new note in monoplane design. This aeroplane, the Tatin-Paulhan torpedo, was distinguished by the fact that the screw, at the extreme rear, was driven through a long shaft by a motor placed in the body behind the pilot's seat. From various causes the Tatin-Paulhan, although perhaps the most efficient machine of its day, was not placed on the market. Louis Paulhan soon turned his attention to Curtiss hydro-aeroplanes, which, however, have since been taken out of his hands.

In response to the desire of the French government for armed aeroplanes several manufacturers have reverted to the Tatin design which permits mounting a gun in the bow. The Borel firm exhibited a machine of this type at the last show in Paris. Unfortunately, owing to lack of orders, the Borel factory is at present closed down. Meanwhile a new "torpedo"—the Ruby—has made its appearance. The fuselage of this machine is of the usual box girder type, tapering toward the bow and stern. The wings are of Blériot section. The empennage is "floating," i. e., it carries no load, being perfectly flat above and below. The elevator flaps have their rear edges cut out to allow room for the propeller. Two unbalanced rudders form the terminations of two fins which, like the horizontal tail surfaces, are triangular in shape.

The landing carriage is composed of two pairs of V struts from which the axle is sprung by means of rubber shock absorbers. It will be seen that the lower wing cables are not attached to the chassis, but to a bottom pylon similar to the upper one. This is a very good feature. On too many machines wing cables are still anchored to the chassis. The danger of doing this comes from the fact that the pilot may crack a chassis strut and go up again without having it repaired.

The spectator is at once struck with the great height of the fuselage above the ground. This is needed to give the propeller sufficient clearance. Also in order to bring the machine to a stop within a reasonable distance the axis of the fuselage is inclined so that the nose is considerably higher than the stern. This, however, is not enough to render the braking effect comparable to that of a standard type monoplane. The great height moreover renders landing on rough ground a rather delicate proceeding attended with some risk of overturning. It may be said that the necessary height of the fuselage is the one great inherent defect in the "torpedo" class of monoplane; the only possible remedy would be to replace the propeller by a Coanda turbine propulsor. The cooling of the motor—an 80 horse-power Gnôme—has been found perfectly satisfactory, thanks to the louvers for the admission and exhaustion of air. Small points to be noted are the neat mica wind-shield for the protection of the pilot, and the aluminium cone effecting the final "run off" of the propeller boss. The span of the "Ruby" is 29 feet 6 inches and length 23 feet.

The F. B. A. Flying Boat.

This hydro-aeroplane, produced by the Franco-British Association, is a development of the Donnet-Lévêque, with which André Beaumont did so much flying in 1912. The company, which was formed last year, also manufactures the Curtiss and d'Artois sea-planes. The creation of this company was an eminently sensible way of solving the difficulty presented by the fact that Curtiss held patents covering the "flying boat," a term used to designate a hydro-aeroplane having a central float serving as a fuselage.

Particular care has been taken in designing the shape of the hull in order to reduce skin friction to a minimum. In this respect the new F. B. A. is an improvement even over the machine exhibited at the Paris Show last winter. It will be noticed that the deck forward has a slight overhang to prevent water being shipped. The ports for inspecting the compartments in the hull can also be seen. The dimensions are somewhat smaller than those of the [illegible] machine, which had [illegible] feet [illegible] inches span and 25 feet [illegible] inches length. The [illegible] horse-power Gnôme motor can be started from the pilot's seat. The controls are standard, i. e., a universally [illegible] lever works the elevator and ailerons, and a foot bar is used for [illegible]

The Bleriot "Total Vision" Monoplane.

This machine, the latest production of Louis Blériot, and shown at the recent Olympia Show in London, resembles the classic "XI," ~~except that~~ the wings are raised above the fuselage to the level of the pilot's eyes. The pilot can see downward as well as if the plane were above him, and also, by merely turning his eyes upward, can see anything overhead. It would be difficult to overestimate the importance of having a clear field of vision both above and below, which has hitherto been unobtainable on tractor monoplanes.

The credit for this innovation belongs to a French military aviator, Lieut. Gouin In the machine with which he has been experimenting he has also incorporated a system of air braking, modifying the wing section and rudder for the purpose. The wings present the ordinary Blériot section near the fuselage, but their angle progressively diminishes toward the extremities, where it becomes zero. The axis of rotation of the rudder forms the summit of a dihedral angle, which in normal flight is closed. When a braking effect is desired the rudder is opened out by a foot-operated control. The braking effect is, of course, proportioned to the opening of the dihedral angle. This feature is especially useful at the moment of landing, as it causes the machine to quickly come to a stop. A Blériot type Gouin has been entered in the Concours pour la Securité en Aeroplane. In the Blériot license Gouin, as the ordinary total vision type is called, the air braking feature is not incorporated.

Owing to the raised position of the wings the lower wing cables work at a more favorable angle than before. The pylon is of the standard "XI" type, but raised on four struts. A two-seater tandem "XI" bis with the total vision feature is now being completed by the Blériot firm.

It will be noticed that Blériot has thought fit to preserve the landing carriage in its original form. This member of the new monocoque is considerably smaller and has, therefore, much less wind resistance While retaining his original chassis Blériot has at last given up the well-known "cloche" control. The wing warping and elevator are now controlled through a vertical lever mounted on a longitudinal rocking shaft. This shaft carries at its rear end a sprocket connected by chain to another sprocket on the lower end of the bottom pylon On the same shaft as the pylon sprocket there is a pulley around which pass the warping wires. The elevator control wires are fastened directly to the vertical lever. The rudder is operated as before by a foot bar. Following are particulars of the Blériot total vision machine: Span, 30 feet 2 inches, length, 25 feet 6 inches; area of main plane, 104 square feet; weight (empty), 682 pounds; useful load, 309 pounds; motor, 80 horse-power Gnôme; tractor, Chauvière; speed, 68.2 miles per hour

The Short Folding-Wing Sea-Plane of the British Navy

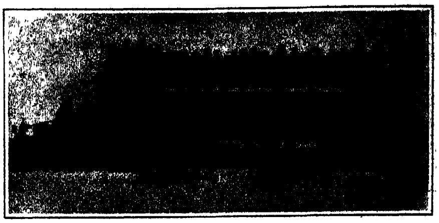
By Major H. Bannerman-Phillips (London)

WHILE Great Britain has marked time too long since the disaster which befell her first large rigid naval airship at Barrow in 1911, and is only now beginning to make some headway with lighter-than-air vessels for oversea work, she has by close attention to detail on the part of constructors and devotion to duty on that of the naval personnel of all ranks concerned with flying, taken the lead in sea-flying, and the latest development of the Short sea-plane marks a long step forward in the matter of equipment for naval aviation. The radius of action of the sea-plane is at present limited, whereas that of the large rigid airship of the Zeppelin type may be put at 750 miles, and communication by wireless over 300 miles has been accomplished; but if the plan be adopted for working the sea-plane from a ship, the actual radius is not so important as it would be otherwise. There are, of course, three main difficulties to overcome in the care of sea-planes using the vessel of war to which they are attached as their base. The first is the question of stowage on board ship; the second, that of starting; and the third, that of alighting or being hoisted on board. It has been suggested as an alternative to this that a sea-plane accompanying a fleet should be fully sea-worthy and capable of riding out bad weather if it should be unable to reach land by its own power. Apart

(Continued on page 405.)

Historic Omnibus "Motorized"

THE accompanying photograph shows an old omnibus which plied between the Centennial Exposition and the City Hall, Philadelphia, Pa., in '76, being drawn by ten horses and carrying loads of from sixty to one hundred passengers The old 'bus has been doing service in Brooklyn for the past thirty-five years with picnic parties and holiday excursionists. It has just been "motorized" with a tractor. In spite of its great age this old vehicle has been well kept, and is in a remarkably well preserved condition; in fact, it is still so serviceable that its owner proposes sending it overland along the Lincoln Highway route to the Pacific Coast to run between the heart of San Francisco and the Panama Exposition.



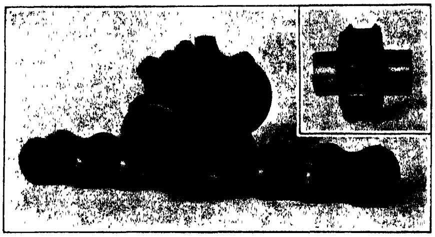
Centennial Exposition omnibus now equipped with a motor tractor.

Indian School of Tropical Medicine

THE American consul at Calcutta reports that the corner stone of the new School of Tropical Medicine at that place was laid on February 24th by the Lieutenant Governor of Bengal, and the institution is likely to be ready to begin work [illegible]. This school will have unique advantages for carrying on its special line of work; viz., the study of tropical diseases, with a view to finding more accurate methods of diagnosis and treatment. Such diseases are responsible for more than one third the mortality in the city of Calcutta. From the consul's report it appears that the new institution aims to become an international center in its particular field, students will be welcomed from all parts of the world, and medical research institutions in other countries are urged to establish scholarships at the Calcutta school, or to provide otherwise for sending research students to enjoy the advantages it offers. Inquiries should be addressed to Lieutenant Colonel Leonard Rogers, I. M. S., Medical College, Calcutta.

Simple Flexible Coupling

A VERY simple flexible coupling has recently been invented which consists merely of two sprocket wheels held together by a roller chain The sprocket wheels are keyed to the shafts that are to be connected, and then the coupling is readily effected by wrapping the roller chain about the two sprockets and clasping the chain with a master link. The shafts may as readily be disconnected. The coupling has great strength because all the teeth are in contact with the chain rollers at one time. A roller bearing, instead of sliding contact is thus provided The chain adjusts itself automatically to all variations of alinement within wide limitations. The coupling has no projecting parts, and hence it meets with all legal requirements for safety.



Flexible coupling consisting of two sprockets and a roller chain.

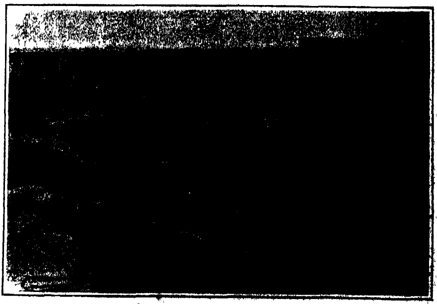
The New First Assistant Patent Commissioner

THE vacancy caused by the death of Mr. Robert T. Frazier will be filled by James T Newton, at present Assistant Commissioner in the Patent Office. On April 24th President Wilson confirmed Mr Newton's appointment as First Assistant Commissioner of Patents. Mr. Newton was appointed to the Patent Office March 25th, 1901, as an assistant examiner. Later he became examiner, and on November 14th last was promoted to the position of Assistant Commissioner.

Mr. Robert T Whitehead of Virginia has been appointed Assistant Commissioner of Patents by the President Mr Whitehead entered the Patent Office as an assistant examiner on February 1st, 1902, and was made a law examiner July 1st, 1909

Motor Car Converted Into Railroad Tractor

MULES proved unsatisfactory in hauling materials about the site for the Marconi wireless telegraph station at Kahuku, near Honolulu, Hawaii, and an old automobile in which the engine was quite sound was resurrected from a life of uselessness and remodeled as shown in the accompanying illustration for use as a narrow-gage railroad tractor. It can readily haul a number of cars. Prompt response with its three speeds forward and reverse has gained this tractor the favor of the workmen, to whom mule power proved as much of a hindrance as a help.



Motor car tractor in Hawaii.

Cottonseed Flour as a Possible Food for Man

By C. A. Wells

ONE of the earliest reported cases of the use of cottonseed flour as a food for man was that in which bread and other articles of food prepared from cottonseed meal were served certain members of the Farmers' Congress held at College Station, Texas, about fifteen years ago. Since that time a number of reports have been made of the use of the meal in human diets

Allison states that many of the smaller cottonseed oil mills of the country are manufacturing so-called "cottonseed flour" and that some of the large mills are producing and disposing of it with profit. It is not manufactured by any secret process, but is simply cottonseed meal of choice color, taste and odor which has been finely ground and thoroughly bolted. As might be expected, therefore, it contains more protein and less crude fiber than cottonseed meal of similar grade and origin. In other respects the chemical composition of the two is essentially the same. The terms "cottonseed flour" and "cottonseed meal" are used synonymously throughout this paper.

Cottonseed flour contains little kneading principle and more than twice as much protein as meat In order, therefore, to facilitate the making of bread and at the same time reduce the protein content of the latter, the flour is usually mixed with some other substance such as wheat flour. Most of the cottonseed flour bakery products found on the market are prepared in this way.

In 1012 there were crushed in the United States 4,921,073 tons of cottonseed equivalent to about 2,160,000 tons of meal. If we make the reasonable assumption that cottonseed meal has a digestibility of 70, then on the basis of the food values one ton of meal has a protein calorific food value of $[illegible] and a total calorific food value of $[illegible]. [illegible] one half of the annual production [illegible] the remaining half was fed to stock or used in making fertilizers. The Interstate Cottonseed [illegible] Association arbitrarily classifies cottonseed meal into three grades: choice, prime and off grades. Choice meal is from choice cottonseed finely ground. It must be perfectly sound, sweet, and of a light yellow color, free from excess of lint and hulls. It might be inferred that meal of this grade would be suitable for human consumption. Unfortunately, however, we have no record of the quantity of each grade of meal manufactured, so that one has no accurate data upon which to base a calculation of the amount of meal even presumably of a grade fit for man's use as a food. On the percentage basis, however, if cottonseed meal can be used as a food for man, and if it has a digestibility coefficient of 70 or greater, then 10 per cent of the meal produced annually in the United States (10 per cent of 2,160,000) would have a total calorific food value of $119,959,920 and a protein value of $106,920,000 (216,000 multiplied by $555.37 and $495.60, respectively). The same meal when fed to stock or used as a fertilizer would have a value not exceeding $6,480,000 (216,000 × $30.00, a liberal commercial value of one ton of meal).

Allison, Thompson, and others state that it is a suitable food stuff for man and that in many cases its continued use has proven highly beneficial. According to Fraps, "we have no reason to believe that cottonseed flour will not be a wholesome food, when used in small amounts to replace meats, or to reinforce a diet poor in flesh food," yet he says further, "we are inclined to believe that the maximum amount of cottonseed meal which should enter into the diet is two to three ounces per day; that the conditions under which such a diet may prove injurious must be established; . . . and that only experience and experiments can tell us the part which cottonseed flour should play in nutrition and under what conditions it may prove unwholesome." The writer has eaten for some time in his own home cakes and bread of various kinds containing a portion of cottonseed flour without experiencing any ill effects from its use.

It should be said, however, that while there are no reported cases of injury from the use of the meal as a food for man, it is possible and indeed quite probable that this is due to its so far limited use for this purpose. The assumption of its unwholesomeness for man naturally grows out of the well known injurious effects which it produces when fed to stock. Investigations are now under way to ascertain the true nature of cottonseed meal toxicity. If this can be done, cottonseed meal or flour may be given to the world as a new and exceedingly inexpensive food with an almost unlimited source.

"Snow Mushrooms"

THIS name is applied by Dr. Vaughan Cornish, in his recent book on "Waves of Sand and Snow," to some remarkable snow formations observed by him in traveling through the Selkirk Mountains, in western Canada. The railway passes through a pine forest, in which many trees have been cut at a height of about 6 feet from the ground. On the tops of the stumps, which are about 2 feet in diameter, snow collects in an overhanging cap like that of a mushroom. These caps, which sag at the border, and rise in a dome in the middle, are generally about 9 feet in diameter; i. e., they project 3½ feet beyond the stumps all around. Of hundreds observed by Dr. Cornish, all were perfect, none having broken with their own weight. Some of them must weigh more than a ton. Several photographs of these curious mushroom-like formations are shown. The whole phenomenon calls for exceptional meteorological conditions, and in this respect is analogous to the "snow garlands" described and illustrated in the SCIENTIFIC AMERICAN of January 27th, 1912.

The Forests of Norway are mostly in private or municipal ownership, the nation owning 28.5 per cent of the total forest area. The national forests of the United States occupy only about twenty per cent of the total forest area of the country.

LEGAL NOTICES

PATENTS

If you have an invention which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

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Inquiry No. 9355. Wanted the name and address of the maker of triplex glass.

Inquiry No. 9356. Wanted the name and address of a manufacturer who can build an automobile wheel, also a *cigar sanding machine.* Concerns in the Middle West preferred.

Inquiry No. 9357. Wanted the name and address of a manufacturer of a machine for scalloped paper favors and cups.

Inquiry No. 9358.—Wanted the name and address of maker of a machine to cut all granulate leather.

Inquiry No. 9359. Wanted the name and address of a firm that makes razor blades for all makes of safety razors.

Inquiry No. 9360. Wanted the name and address of parties making pipe fittings such as ferrules, stems and bowls such as could be used in the making up of calabash pipes for smoking.

Inquiry No. 9361. Wanted to buy a Nut Cracking Machine, especially good for pecans.

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Inquiry No. 9364. Wanted the name and address of buyer of mica in a crude state.

Inquiry No. 9365. Wanted the name and address of a manufacturer of machinery for embossing tin foil as is used in packing cigarettes.

Inquiry No. 9366. Wanted the name and address of a manufacturer of wire wheels, front axles complete with steering or [illegible], light sheet metal bodies, [illegible] with [illegible], pressed steel frames, [illegible], motors of the two-cylinder opposed type, cushions and many smaller parts for cycle cars.

Inquiry No. 9367. Wanted the name and address of a manufacturer of an automobile [illegible] machine.

Inquiry No. 9368. Wanted the name and address of [illegible] manufacturers or glass blowers who can manufacture a glass bottle and package it with [illegible], in large quantities for export, to sell at a popular price.

Inquiry No. 9369. Wanted the names and addresses of [illegible]. [illegible]

[illegible]

NEW BOOKS, ETC.

NAVAL WARFARE. By James R. Thursfield, M.A. With an Introduction by Rear-Admiral Sir Charles L. Ottley, K.C.M.G., C.B., M.V.O. New York: G. P. Putnam's Sons, 1913. 16mo.; 151 pp. Price, 40 cents net.

"Naval Warfare" is sufficiently technical without being tedious. Very few men, even among the well informed, know anything of even the broadest principles of the conduct of sea fighting, although these principles are, as Sir Charles Ottley says, precisely the same to-day as they were at Salamis and Lepanto. The little work briefly but very readably discusses the command of the sea, disputed command, invasion, commerce in war, and the differentiation, distribution and supply of naval force. It is the vote of the civilian that provides or withholds ships and munitions of war, and it is the duty of every civilian so to familiarize himself with the basic conditions of success in warfare that his influence may be exerted intelligently. Prof. Thursfield's manual, if universally read, would greatly forward this happy consummation.

COAL TAR DISTILLATION. And Working Up of Tar Products. By Arthur R. Warnes. New York: D. Van Nostrand Company, 1914. 8vo.; 185 pp.; illustrated. Price, $2.50 net.

The complex mixture known as coal tar is the basis of a very considerable industry, and a compact, up-to-date work dealing with the industry in its many phases will be appreciated by students, managers of plants and technologists. In brief but informative chapters, the author discusses the various processes used in distillation, in the recovery of acids, benzols and pyridine acids, and in the manufacture of such products as crude naphthalene and anthracene. Tar works' tests are given in the final chapter. Throughout the text figures are tabled for change-over points, temperatures and results. These are taken from actual practice, and will be helpful in a large degree, though the author warns the student that coal tar and its distillates are variable mediums, and processes that have succeeded in some instances might have to be modified in others.

INCANDESCENT ELECTRIC LAMPS. And Their Application. By Daniel H. Ogley. New York: Longmans, Green & Co., 1914. 12mo.; 107 pp.; illustrated. Price, 80 cents net.

Recent improvements in electrical lighting mean chiefly improvements in the filament. The semi-popular handbook offered in "Incandescent Electric Lamps" eliminates much phraseology that has been unintelligible to the layman, and aims at filling "the obvious gap." Illumination and its measurement, standard light sources, light distribution, the eye and the principles of vision—these captions give some idea of the discussions involved. Direct and indirect lighting systems are explained and contrasted, and it is hoped that the general reader may profit to the extent of acquiring such information as may enable him to select the best instalment *for his own particular needs.*

THE SHIPPING WORLD YEAR BOOK. 1914. Edited by Major Jones. London: The "Shipping World" Offices. 8vo.; 1912 pp. Price, $4.

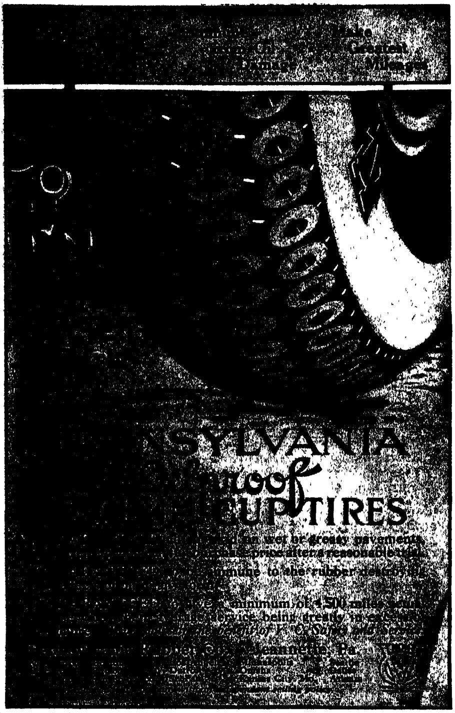
The "Year Book" is issued as a desk manual in trade, commerce and navigation, and is too well known to require a lengthy description. It is packed from cover to cover with thousands of facts having a direct bearing on the shipping business. Prominent among its offerings are the tariffs of all nations, a complete port and harbor directory of the British Isles and a directory of all the commercial ports of the world, with particulars as to accommodation, charges, tides, trades, pilotage and towage. Bartholomew's latest map of the world is, as usual, a feature of the new edition, and shows in distinguishing colors steamship and railway routes the world over.

THE FERTILITY OF THE SOIL. By Edward J. Russell, D.Sc. (Lond.) Director of the Rothamsted Experiment Station. New York: G. P. Putnam's Sons, 1913. 16mo.; 128 pp.; illustrated. Price, 40 cents net.

No grower can afford to ignore the basic processes of plant growth and the attainment of maximum fertility for his ground. In this little volume close attention is given to means for raising the fertility limit, and the illustrations show striking results. Partial sterilization, by toluol or by heat, effects a marvelous increase in crop. The six vital requirements—moisture, air, heat, nourishment, root room and freedom from harmful factors—are intelligently discussed. Phosphates are, of course, given the attention they deserve.

MOUNTAINS. Their Origin, Growth and Decay. By James Geikie, LL.D., D.C.L., F.R.S. New York: D. Van Nostrand Company, 1914. 8vo.; 311 pp.; illustrated. Price, $4 net.

The author is peculiarly successful in conveying hard facts in a pleasurable manner without catering to sensationalism on the one hand or losing the average reader by technical intricacy on the other. His discourse classifies mountains as original or tectonic—including the volcanic and epigene types of accumulation mountains—and subsequent or relict mountains. It is the borderland of geology and geography through which we are guided so masterfully in this fascinating journey of exploration. We investigate old Scottish volcanoes and glacial and aeolian hills; we study the architecture of the Alps; we plumb the submarine [illegible] of the Pacific. The many [illegible] accompanying the work are of a high order.



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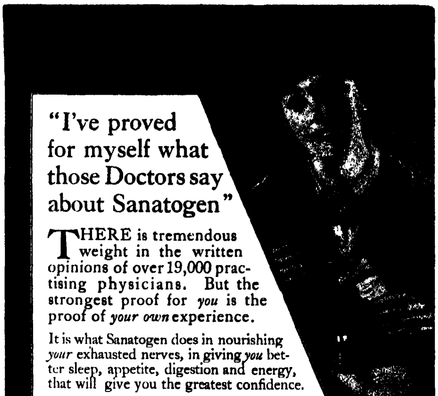

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to which our attention is called. The numerous diagrams are carefully drawn, and such folding inserts as the bathyorographical map of the Pacific Ocean and the cross-sectional layouts of the southern uplands of Scotland are vastly instructive. Prof. Geikie is an adept at turning for us the captivating pages of the past and in giving us new eyes with which to view the present.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12989) G. H. asks 1. How much will a cubic foot of air weigh when compressed to 6,000 pounds on the square inch? A It will require four hundred atmospheres to produce a pressure of 6 000 pounds per square inch, and this will compress the air about four hundred times We say about, since Boyle's law is only approximately correct at high pressures. Air at normal pressure and the freezing point weighs 0 08071 pound per cubic foot At four hundred atmospheres a cubic foot will weigh four hundred times as much, or about 32 284 pounds. 2. How many parts of air will one part of liquid air make when evaporated? The idea being that it would be better to use liquid air than compressed air for certain purposes when desired to use such away from the compression plant A It requires about 800 cubic feet of ordinary air to make 1 cubic foot of liquid air This when evaporated will yield 800 cubic feet of air again If liquid air were retained in a closed vessel, the ultimate pressure would be about 12,000 pounds per square inch We should prefer to be elsewhere when this happened Liquid air is never kept in a closed vessel No railroad would receive it for transportation except in open vessels, so that evaporation can go on freely.

(12990) W. N. G asks: Would it be too much to ask of you to explain the cause of well-defined pictures of various objects such as ships, wrecks fine buildings, well-known landscapes and various other familiar things, which may be very long distances away, appearing in the frost on windows on very cold days? A scientific explanation of this very strange freak of nature would very much interest me, and probably all of your readers and subscribers A When we were children living in a region much colder than New York, we often saw shapes formed by the frost on the window pane, such as those you mention, but we never thought them real copies of objects beyond our horizon We thought them fancies of our imagination We do not now know any reason why they should be other than resemblances in the delicate tracery of the frost We have no scientific explanation for their being any more There is no possible way in which a ship could produce a picture of itself beyond its horizon

(12991) F C. S asks: Will you kindly inform me upon the following to the best of your ability? On my auto I have four new wheel caps that hold the wheels on the axles Those caps are made of hardened steel, the outside of which is nickel plated What is the reason, when these caps get wet and stand for a day, the nickel plate blisters and flakes off? These caps are new Is there anything I can do to the caps to prevent this action on the nickel, and why does the nickel plate blister and flake off hardened steel when it does not do so on other metals that are plated in the same solution? A The coating of nickel on the pieces of hardened steel does not have as good contact as it would upon soft steel or iron, nor is the nickel continuous It has pores in it, through which the moisture comes into contact with the steel, and steel rusts much quicker than iron. The great increase in the use of steel is not without its drawbacks Our galvanized iron and tin plates are no longer made of iron, but of steel, and they are by no means as durable, nor does the coating of zinc or tin adhere so strongly as it did upon the softer and more porous iron plates which were used before the steel processes were developed.

(12992) G. M asks: Is it possible to construct two vertical lines parallel to each other by means of a freely suspended plumb bob? A. It is not possible to construct two vertical lines by means of plumb lines near each other. Neither can vertical lines be strictly parallel to each other Vertical lines converge and meet at the center of the earth If two plumb bobs are hung near each other, neither will hang perfectly vertical They will draw each other slightly from the vertical by their gravitational attraction for each other. It was by an experiment of this sort that the earth was weighed. For this, see Young's "General Astronomy," page 110. We send the book for $3 05 postpaid.

(12993) P. P. C. asks: Will you kindly give me the proper explanation as to why, in moving pictures the wheels of vehicles seem to revolve backward? A. If the spokes of a wheel in a moving picture keep time with the exposures, so that the spokes are in the same position in all the pictures, the wheels will be seen to stand still on the screen. If the spokes succeed each other either faster or slower than the exposures of the film, the wheels will be seen to be turning forward or backward, as the case may be. We have observed all three phenomena. They do not always seem to revolve backward.

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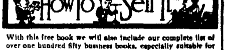

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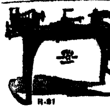
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A Rare Opportunity for a Capable Inventor

By E. W. McCormack

THERE is at the present time an unusual opportunity for an inventor and a manufacturer, to place upon the market a device for which there exists a large demand. The device for which hundreds of firms are seeking, is one that will assist them in putting up their pay-rolls.

Everyone conversant with the subject realizes that the present method of analyzing the denominations of currency needed by cashiers and paymasters, is one of the most troublesome, inefficient and wasteful operations in connection with the weekly or semi-weekly pay-roll. What is needed is a device which will operate upon the principle of an adding machine, but instead of accumulating totals the device should be designed to segregate the amounts into the required denominations.

For illustration, if the first item on the pay-roll is $15.78, it requires a mental operation for the cashier to segregate, upon a separate list, the items which go to make up the amount, i. e., one $10 bill, one $5 bill, one 50-cent piece, one 25-cent piece, and three 1-cent pieces. The entire pay-roll is analyzed in this manner, so that when the pay-roll check is presented at the bank a memorandum accompanies it, calling for bills and coin in the following amounts:

106	$10.00	bills
71	5.00	bills
97	2.00	bills
313	1.00	bills
118	0.50	coins
63	0.25	coins
1,149	0.10	coins
211	0.05	coins
953	0.01	coins

Thousands of firms realize that they are wasting valuable hours, which yearly cost them hundreds of dollars, according to the size of their pay-roll, because there is no simple, efficient, labor-saving device which will enable them to add up the total of their pay-roll and segregate the items into the proper units. Many concerns have their cashiers guess at the amounts, and often their guesses are not good, but, however good the guesses, it simply means that the larger the pay-roll, the more pieces of money it is necessary to handle, because if guesses are made, more bills of smaller denominations must be specified than needed, consequently when two thirds through the pay-roll, it becomes necessary to pick up and count five one-dollar bills instead of having one five-dollar bill.

It should not be any great mechanical problem for an inventor to produce a combination adding machine and pay-roll device, so that the cashier could strike keys 15.78 and have the machine print a line similar to the following illustration:

Amount	$10 00	$5 00	$2.00	$1 00	50c.	25c	10c	5c.	1c.
15 78	1	1	.	. . .	1	1			3
20 15	2	. .	. .	.			1	1	
18 86	1	1	1	1	1	1	1		1
12 11	1	. . .	1				1		1
14 51	1	.	2	.	1				1
etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.
2131.73	106	71	97	313	118	63	1149	211	953

Such a device as this could be sold for $100 or $200, and the time saved would pay for the machine several times over in the course of a year, as the present method is slow and inaccurate, and, as before stated, one of the most troublesome problems in connection with the handling of pay-rolls.

This opportunity for an inventor is unusual because invariably the majority of inventions of an entirely new idea are ahead of the times, or in advance of actual demand for the device. Regardless of the merits of the invention, if there is no demand, it means that a great amount of educational work must be done before a market can be created. The cost of an efficient sales campaign, along educational lines, coming as it does directly after the experimental and manufacturing expense, is responsible for many disappointments and failures. In many cases it is the man who takes hold of the proposition after the ice has been broken who reaps the greatest financial reward; but, in this particular case, there is a demand already created, as firms are asking for, and willing to buy, such a device, and there is at present nothing to be obtained which will do the work.

New European Designs in Aeroplanes

(Concluded from page 401.)

from the difficulty of finding a suitable engine for such a machine, this would place serious limits to its action, and it might be on land and in its hangar just when most wanted by the vessels at sea; and as to riding out a storm, say under the lee of one of the warships, in the first place, even a boat-shaped hull of the size of a sea-plane, although without the top-hamper of wings, etc., could not be expected to stand all weathers, whereas the planes would offer such a surface to a storm as to make destruction certain. In the second place, the warship under whose lee it would take shelter would be seriously hampered by having to remain in position, since it might have to proceed elsewhere at speed.

It is obvious, therefore, that a sea-plane intended for use with a fleet must be "mothered" by a large vessel and able to not only start its reconnaissance flights from the ship as a base, but send back information while away, and at any time return to it for protection in case of bad weather and get taken on board

The Short folding-wing sea-plane goes far toward solving the problem of providing a machine which can fulfill these conditions. It is a tractor biplane and has a very wide and relatively shallow fuselage, rectangular in section, with ash longerons and spruce struts. The engine is a 100 horse-power 14-cylinder Gnôme, mounted in steel housings within the fuselage members, and surrounded by a sheet metal cowl with air-holes in the top front for cooling purposes, and on the top there is a chimney to carry away both the air and the exhaust gases The rounded engine cowl is carried back and tapered off into the fuselage proper behind the pilot's seat, being cut out and shaped to form a windscreen for both pilot and passenger At the rear of the fuselage is the empennage, consisting of a cambered fixed tail-plane, followed by divided elevator flaps, a fixed vertical fin and a balanced rudder

It will be some time before sufficient experience will have been gained in handling this type of machine on board a warship to say how far the arrangement for folding the wings is of advantage in lowering on the water surface and hoisting inboard, but it has the merit of simplicity, and there can be no doubt of the value of a system which permits of reducing a span of 60 feet to a width of 9 feet when stored in a hangar, a process which only takes a few minutes in this case

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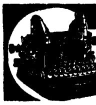
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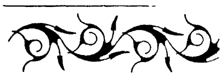
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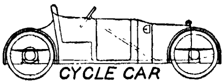
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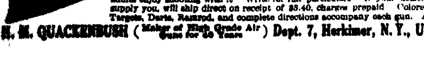
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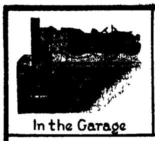
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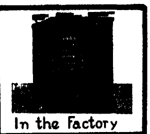
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machines the requisite shed accommodation for an aeroplane base is reduced to one fifth or one seventh, and that this great saving in the cost of sheds will have the result of increasing the amount of money available for the purchase of machines. They also maintain that the value of the folding sea-plane was proved conclusively in the last British naval maneuvers in 1913, when a 160 horse-power Short folder sea-plane was carried on an ordinary warship without the slightest inconvenience (owing to its compactness) and was launched and reshipped many times without the slightest hitch, performing evolutions in rough weather in the North Sea, and that their invention has made possible the project of having an "aeroplane ship" or mother vessel to carry twenty to thirty machines, for which plans are already out.

A noticeable feature of the Short folder sea-plane is that the wings can be folded or spread out at will by the occupants of the machine, while it is floating on the water, a small winch being provided in the machine for this purpose, the whole operation being completed in two minutes. The same operation has been completed in the same time on land at the end of a 7-mile journey, during which the machine was "towed" by road with folded wings, but fully equipped and ready for flight so soon as the wings were spread. In the same way it is possible to carry the machine on board ship, hung in davits, fully equipped and ready to be launched at a moment's notice. Very special care has been taken in the design of the hinges and fastenings for the folder sea-planes and the seven tests to which the "short" machines have been put by the British Admiralty are understood to prove that the strength of the whole structure has been increased by the adoption of the folding-wing fittings.

Aeroplanes have, of course, been launched from special platforms on warships before now and alighted on them in similar fashion, but the carriage on deck of a machine of the ordinary type is obviously out of the question, and the taking down and putting together again for each flight would consume much valuable time; moreover, it would increase the wear and tear of the parts very considerably.

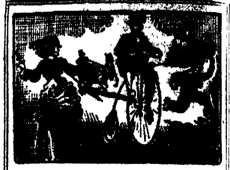
A Disastrous Colonizing Experiment

FOUR years ago a Russian company undertook to establish a permanent fishing colony in Nova Zembla, and transported thither about 100 persons—fishermen and their families—from Archangel. The colony flourished for a time and increased in numbers. It was visited at irregular intervals by vessels of the company, which supplied the settlers with provisions and took cargoes of fish back to Russia. Last year, however, the Winter set in earlier than usual and was very severe, so that vessels were prevented by the ice from carrying supplies to the fishermen. A scientific expedition which visited Nova Zembla last Summer made the shocking discovery that the whole colony had perished of hunger

Vulcanological Observatory in the West Indies

IT is proposed to establish on the island of St Vincent, West Indies, a vulcanological observatory and laboratory, as a memorial to Dr. Tempest Anderson, the distinguished English vulcanologist, who died last August while on his way home from a visit to the volcanoes of the East Indies. Dr. Anderson was sent by the Royal Society to make a study of Monts Pelé and Soufrière immediately after the eruptions of 1902, and also made subsequent studies of West Indian volcanoes.

Moving Pictures in the Army.—Every day brings to light new uses for kinematography. During the recent encampment of a brigade of cavalry near Winchester, Va., a number of new formations and evolutions were introduced. Moving pictures were taken of these movements and the films will be displayed at military posts for the instruction of officers and men.



Did You Ever Ride a High-Wheeler?

Those old-fashioned two-story bicycles were the gay deceivers, all right!

You needed a stepladder to mount one of them—and only half a second to get off. They never stood on ceremony when they got ready to buck.

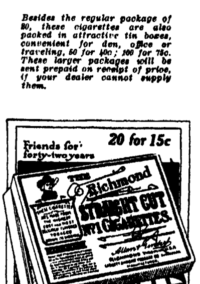
Seems an awful long time since they were the vogue. So long ago that the last of them must be in the museums by this time.

The encyclopedia says the first high-wheel bicycle was brought to this country from England in 1876.

That was five years after Richmond Straight Cuts were first introduced to the American public.

They both made a big success. But while the high-wheel bicycle is *gone* forever—Richmond Straight Cuts *go on* forever They will ever be the best of all Virginia Cigarettes.

Besides the regular package of 20, these cigarettes are also packed in attractive tin boxes, convenient for den, office or traveling, 50 for 40c; 100 for 75c. These larger packages will be sent prepaid on receipt of price, if your dealer cannot supply them.



SPARK COILS
AND THEIR CONSTRUCTION

160 describes the making of a 1½-inch spark coil and condenser.
1514 tells you how to make a coil for gas-engine ignition.
1522 explains fully the construction of a jump-spark coil and condenser for gas-engine ignition.
1124 describes the construction of a 6-inch spark coil.
1087 gives a full account of the making of an alternating current coil giving a 5-inch spark.
1527 describes a 4-inch spark coil and condenser.
1402 gives data for the construction of coils of a definite length of spark.

This set of seven papers will be supplied for 70c. Any single copy will be mailed for 10c.

Munn & Co., Inc., Publishers, 361 Broadway, N.Y. City

SCIENTIFIC AMERICAN

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Beacons for Airmen

Vol. CX. No. 20
May 16, 1914

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

A Prize of

$1000.

For the best house of the year

In the interest of better homes *Country Life in America* offers a prize of a thousand dollars, which will be paid to the owner of that house, occupied for the first time within the year 1914, which, in the opinion of the judges, attains the greatest all-around excellence. It is hoped that the award will so justify itself as to cause this offer to be repeated year after year.

CONDITIONS

The house must be a country or suburban home, first occupied between Jan. 1, 1913 and Jan. 1, 1914. It must have cost not less than $5000, exclusive of the land and interior furnishings. It must be a year-round home, completely equipped with heating, plumbing, etc.

BASIS OF AWARD

It is intended that the best house of the year shall win the prize. The cost will not enter into the matter at all, so that a $5000 house will have just as much chance of winning as one costing many times that amount. To this end the entries will be judged on a point system, in which the 100 points representing perfection are divided as follows: plan, 35; exterior appearance, 25; interior equipment and furnishing, 25; setting (by which is meant the arrangement of paths, garden and planting in the immediate surroundings), 15.

ENTRY REQUIREMENTS

The competition is open to any house built on the North American continent conforming to the "conditions" above stated. (The owner need not necessarily be a subscriber to *Country Life in America.*) Each house must be represented to the judges with the following material, which shall be in the hands of the Competition Editor, *Country Life in America*, Garden City, L. I., on or before July 1, 1914: (1)—Plans of first and second floors in black on white paper, drawn to a given scale or dimensioned. (2)—Sketch block plan of house and immediate surroundings. (3)—At least 8 photographs, not smaller than 5 x 7 in., of which not less than three shall be of the exterior, nor less than one each of living-room, dining-room and owner's bedroom. (4)—A typewritten description of about 1000 words, supplementing the photographs and plans and describing materials, color schemes and special points of construction, arrangement and furnishing.

THE JUDGES

Mr. Guy Lowell, architect and landscape architect, of Boston; Mr. Howard Van Doren Shaw, architect, of Chicago, and the Editor of *Country Life in America* will be the judges. These three will designate the winner of the prize and will award honorable mention to such other houses entered as may in their opinion merit it.

$1000 to the owner—a gold medal to the architect

$1000 will be paid to the owner of the house selected as the best of those submitted. A gold medal, suitably engraved, will be awarded the architect of the same house.

Plans, descriptions and photographs entered will be returned only to those enclosing postage or express return charges. The material describing the prize-winning house will become the property of *Country Life in America*. The material describing houses awarded honorable mention may be retained and paid for at the magazine's regular rates.

The prize house and a number of those awarded honorable mention will be published in *Country Life in America*. "The Best House of the Year" appearing in the October (1914) Annual Building Number. Arrangements are now being made to exhibit photographs and plans of the successful houses in several of the larger cities.

Country Life in America

MAIL THIS NOW WITH A DOLLAR BILL

Si Am
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Dear Sirs
For the enclosed $1 send
me *Country Life in*
America for 6 months—June
to October, inclusive

DOUBLEDAY PAGE & CO
Garden City New York

Further information regarding the award will be published in *Country Life in America* throughout the summer. You must have these forthcoming issues and the October Building Number with the $1000 *Prize House*. Sign the coupon and mail it now.

SEVENTIETH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CX
NUMBER 20.

NEW YORK, MAY 16, 1914

PRICE 10 CENTS
$3 00 A YEAR

Analyzing the Human Singing Voice

UNTIL the present day the nearest approach to accuracy in the gaging of musical tone has been afforded by the human ear. Those interested in the development of their own voices or of the voices of singers or students have been as dependent upon the not altogether faithful and infallible judgment obtained by the individual sense of hearing as the importer or distributor of tea or coffee is dependent upon the verdict of the professional sampler, or taster.

As the sense of taste is seldom exactly the same with two persons, and tea tasters will often be found to disagree as to the flavor and quality of a brand they may be sampling, so the sense of hearing is subject to disagreement—the more so, indeed, because its impressions are of a transitory nature and derived from abstract and not from physical subjects. This is shown by the indefinite terminology used by the voice teachers and critics in their work of vocal tone description. On the other hand, the sense of sight is held to be the most accurate and unfailing, because it has the advantage of a permanent material object that may be deliberately studied and analyzed. It is by far the most discriminating sense we have, and, therefore, impressions received through it are capable of exact description.

Photographic tone analysis is an ultra-modern device of science, which promises to exert a vital influence upon the development of the voice, as, indeed, it may, also, upon the manufacture of musical instruments. It is in the formulation of the theory of correct tone production that the exact analysis of tone by photography has accomplished its most valuable function thus far.

Dr. Floyd S. Muckey of New York city, who was associated with the late William Hallock, professor of physics at Columbia University, in a scientific investigation of the physical laws of the voice which lasted more than twenty years, has evolved a scientific method of voice production, a method which especially takes into consideration the factor of interference with the correct action of the voice mechanism. It is by photographic tone analysis that he specifically sets forth the part which interference plays in preventing the full use of the vocal capabilities. Interference is also shown to be the direct cause in the deterioration of the vocal instrument. He accomplishes his analysis of vocal tones, and, likewise, his analysis of instrumental tones by the use of the Koenig manometric flame analyzer which has been greatly improved for this work by Prof Hallock

The photographic "tone analyzer," as the apparatus might more popularly be termed, provides an actual and permanent record of tone quality and shows the definite convention of cause and effect between interference with the mechanism and the resulting tone How these tone photographs bear out the principles advocated by him is thus outlined by Dr. Muckey:

"The roof of the mouth ends posteriorly in the soft palate, which rises in the act of swallowing to prevent the entrance of food into the cavities of the upper pharynx and nose. If the soft palate is raised during voice production, these important cavities, constituting the larger part of the resonance space, are shut off and the apparatus records the loss of the four highest partial tones, showing a decided reduction in the strength of the pitch, or fundamental, tone A voice loses more than half its volume, i. e., its intensity and carrying power, by this great loss of resonance space. Any contraction of the muscles (*palato-pharyngei*) of the soft palate attached to the large cartilage of the larynx (*thyroid*) interferes with the pitch mechanism"

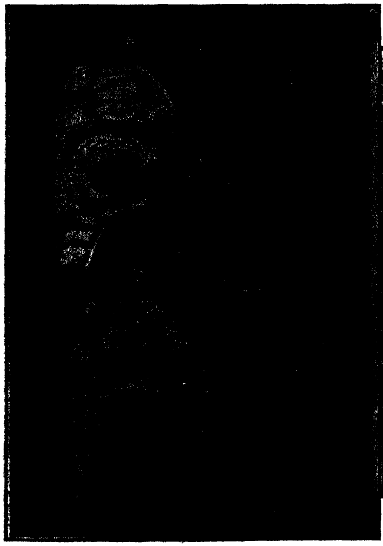
This apparatus photographs, not tone, but the vibratory effect of air-waves from the source of tone production, as projected through Helmholz spherical resonators, attuned to the fundamental and characteristic overtones, upon tiny jets of gas-flame whose fluctuations are caught by a camera lens The resulting impression recorded upon the photographic plate is a series of horizontal lines of light picturing the motion of the flames and accurately representing the vibrations of a single string tone, as divided into the fundamental tone and its six or seven overtones These make up the complex tone of any single tone sounded either by the voice or by a musical instrument of the string family

"The results of the operation of this apparatus are shown in the accompanying photograph of the vibrations of a vocal tone The lower C, as produced by the voice mechanism in the vowel "a" (as in "father"), upon the pitch of a standard fork (128 vibrations per second) is given. The number of vibrations that the fundamental tone bears to the rate of its overtones, harmonics, or upper partials, is in the ratio of 1 to 2, 3, 4, 5, 6, etc. Hence, the resonators are attuned to bass C, and its seven overtones, whose rates of vibration and approximate pitches are as follows:

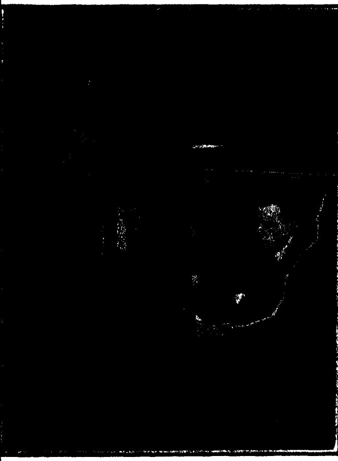
Fundamental,	128	vibrations	per	second,	about	bass C
1st overtone,	256	"	"	"	"	middle C
2nd "	384	"	"	"	"	" G
3rd "	512	"	"	"	"	high C
4th "	640	"	"	"	"	" E
5th "	768	"	"	"	"	" G
6th "	896	"	"	"	"	" B flat
7th "	1,024	"	"	"	"	C in alt.

"The analysis is made so that we may describe each

(*Continued on page 421*)

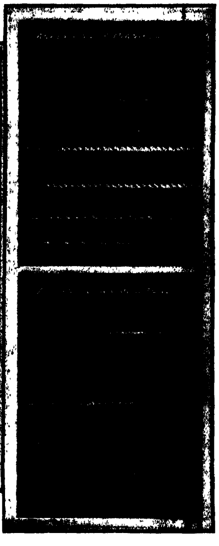


The effect of correct and incorrect placing of the soft palate is shown by the photographs of tones appearing opposite the mouths. Note that when the full resonance capacity of the nose is used, as in the upper picture, a strong fundamental tone with good overtones is obtained; the lower picture shows how markedly poor is the effect when the soft palate is up. The photographs of the fundamental tones and the corresponding overtones, appearing opposite each drawing of the human head, were obtained by means of the improved Koenig manometric flame apparatus shown in the center engraving on this page. They give instrumental evidence (better than any personal opinion) of the effect which the position of the soft palate has on tone production.



The Koenig manometric flame analyser consists of a number of Helmholtz resonators connected by tubes with gas jets As the subject tested sings, the flames vibrate They are reflected in the vertical mirror, which the operator can turn by hand, so that the vibrating flames are seen as in the photographs on the left hand side of this page. The mirror is not used in making the photographs; a plate holder in a camera is merely shifted laterally during exposure, thus producing the effect shown in our picture. Before the late Prof Hallock of Columbia University improved the Koenig manometric flame analyzer photographs such as those reproduced on this page could not be made Experimenters made drawings by watching the reflection of the flames in the mirror. The photographs herewith reproduced are among the first ever obtained by means of the Koenig apparatus.

Analysing the singing voice.



Tones of the pianoforte and violin, respectively, sounded upon lower C. In the piano record the fundamental tone represented by the first line is weak, but the overtones are highly developed. In the violin record the lower line, being bass C (128 vibrations), records no air waves, because air-waves of that length were not sounded; the second line is the octave of bass C (256 vibrations) and the fundamental of this set of partials.

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NEW YORK, SATURDAY, MAY 16, 1914

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Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The All-steel Aeroplane

IT is a curious anomaly that in this age of steel construction such a large amount of wood should be used in the building of aeroplanes In the sister art of yacht construction wood has been abandoned, except for a few uses, entirely in favor of steel and the high-grade alloys. Why has not a similar substitution been made in the aeroplane, where the demand for weight-saving is scarcely less insistent than it is in the racing yacht?

A few years ago it would have been near the truth to say that this clinging to wood construction was due to conservatism—an unwillingness to change from the familiar to the less familiar. The gliders of the early experimentalists were made of wood and canvas; so was Wilbur Wright's first power-driven machine; and in an art so novel as that of flying, whose votaries, generally speaking, were men possessed of more daring and enthusiasm than they were of technical knowledge, it can readily be understood that there was a disposition to cling to the forms and material, with which Wright made his classic flight at Kitty Hawk

Wright himself was not free from this prejudice in favor of wood for aeroplane construction. The writer remembers discussing with him at the Belmont Park meeting the subject of the SCIENTIFIC AMERICAN design for an all-steel racing monoplane. Wright acknowledged that the theory of the metal machine was correct; but turning to the "Baby Wright" machine which was standing nearby, he patted one of the wooden struts and voiced a sentiment which is strong, even to-day among aeroplane builders, by saying: "This is the material for the aeroplane; I know what it can do, and it gives some warning of a failure."

Yet, it is a fact which cannot be disputed, that compared on the score of strength for weight, and of reliability, the steel and other alloys are vastly superior to wood, even for such special requirements as those of the aeroplane.

The main transverse spars in the wings of a monoplane are not subjected to any more complicated and severe stresses than is the mast of a racing yacht. The compression in the spars, due to the pull of the guy wires, finds its counterpart in the compression of the mast due to the pull of the shrouds; and the transverse bending stresses, applied to the spars at the wing cross-ribs, find their counterpart in the bending stresses on the mast due to the pull of the mast hoops—yet the yacht designer has not hesitated to abandon the wooden mast and the wooden boom and substitute spars built up of steel.

We note that our esteemed contemporary, *The Engineer* of London, which has long been an earnest advocate, like ourselves, of the substitution of metal for wood in aeroplane construction, ascribes the reluctance to make the change largely to the difficulty of obtaining the shapes which are required for the framing, and particularly for the struts, as used in the biplane. There is no doubt that aeroplane construction calls and will ever call for unusual shapes. But it is certain that, as in the case of the automobile, when once the request for shapes of special metal and special form has become general, there will be a lowering in the price due to the increased demand.

Some Points in Cup Defender Construction

IT is probable that there is no structure built of metal in which the stresses are so complicated, or in which they approach so near to the breaking point, as in the modern steel-and-bronze yacht, and particularly in such yachts as are built for the "America's" cup contest. The hull of such a yacht consists of a steel frame, overlaid with a shell of bronze plating which is not much thicker than the outside cover of a good-sized book. The form of this hull has been calculated with the greatest nicety, and to secure the best speed results, it must, in spite of its fragility, be held true to form—there must be no distortion. The problem of making the yacht at once extremely light and extremely rigid is complicated by the fact that the heavy stresses to which it is subjected tending to distort, if not to pull it apart, are not distributed evenly throughout the boat, but are applied with great intensity at certain points of concentrated stress. Thus, there is the enormous upward pull of the shrouds applied at the side of the boat, and abreast of that the even heavier downward thrust of the mast, tending bodily to burst out the floor of the yacht at that point, and necessitating the construction of a widespread mast-step, to distribute the stress over a large area of the hull.

It is interesting to recall the fact that in the case of the first extremely light metal boat built for the defense of the cup, "Defender," during a knockdown in a squall, this very result of thrusting the mast through the floor came very near happening. The "Defender" was subsequently *strengthened* at this point by carrying wide steel straps from the foot of the mast to the channels at the junction of deck and side of hull

As we have said, every conceivable form of stress is applied to a racing yacht. The hull is subjected to severe alternations of compression and tension; and heavy torsional stresses, tending to twist the hull about its longitudinal axis, are applied when the yacht is heeled well down under her press of canvas. In the earlier metal boats the presence of these severe stresses was revealed by the frequency with which a rivet head would snap off, particularly when the yacht was heading into a sea; and it was not unusual under such circumstances for leakage to be quite severe. Indeed, we have heard it stated, and it is quite conceivable, that the inflow of water along the leaking seams, was at the bottom of the "Valkyrie"-"Defender" controversy in the days of Lord Dunraven.

However, with the steady improvement in the quality of materials available for hull construction and for standing and running gear, the yacht designer is, to-day, able to build with exceedingly light scantling. He may edge up very closely to the "factor-of-safety" line, without being harassed with the fear of breakdowns which haunted the designer of ten or fifteen years ago.

The New York County Medical Society and the Press

THE extent to which medical men may participate in the enlightenment of the public through newspapers and magazines has been the subject of discussion within the past few months. In New York city the Medical Society of the county, through its Board of Censors, has delivered a pronunciamento on infractions of the code of professional ethics, and there have been summoned before it physicians and surgeons of standing whose names have figured in popular articles where facts of medical or surgical progress have been obtained with their co-operation or at least their consent. Discipline also has been threatened practitioners who might be guilty of possible or even constructive indiscretions of publicity.

While something may thus have been accomplished toward checking the unwholesome self-advertisement to which many physicians, both great and small, have yielded, there is manifest a reactionary tendency toward suppression of information on medical topics. Every true scientific man must view with approbation the spread of sound and wholesome knowledge of hygiene and disease among people at large. If the New York County Medical Society persists in its present absurd policy it will only hinder the more general popular appreciation of physicians and surgeons as a class; it will withhold from the public a knowledge of scientific achievements and efforts.

That self-seeking practitioners, and not only charlatans and quacks, may acquire undeserved and fictitious newspaper reputation and be able to impose on a credulous public to its manifest detriment is so obvious that the medical profession should protect itself. But such abuses, real or fancied, should be judged solely on their own merits, instead of being connected with the dissemination of proper and correct medical intelligence. Because a reckless reporter has sinned that is no reason why conscientious writers for the press—men who take the trouble to have their writings approved before publication—should not continue to present information in a popular way. Why it is unethical for an American physician to have his name [illegible] in connection with an [illegible] cable dispatches from Europe [illegible] achievements of his fellow-workers [illegible] height of absurdity. So, too, the [illegible] in regard to work of high merit or [illegible] deep interest and concern to the public, [illegible] of the old high-priest days of science than of the twentieth century. If the laity were to receive authoritative, accurate, simply worded information as to progress in medicine, surgery, and hygiene, with the new and essential features emphasized, if safe and sane conclusions as to the future usefulness of new discoveries are drawn, who can question that a much more sympathetic attitude toward medicine would ensue and an appreciation of medical men more nearly approaching that found in Europe would be produced?

In spite of all the harm done by sensational publications there are many periodicals in which the discussion of medical topics could be carried on in a simple, healthful, and beneficent manner. But that is possible only if editors have the co-operation of the medical profession generally, and if their efforts to secure absolute accuracy and reliability are supported in greater part.

To-day scientific medicine depends upon the dictum of no authority whose *ipse dixit* is accepted with awe and reverence almost superstitious. Not the utterance of a man, but the demonstration of scientific truths in the careful regimen of the laboratory convinces in these scientific days. Once a discovery has been announced to the medical profession, once it has withstood the criticism of those competent to judge, it should be authoritatively brought to general attention. Only in this way can the public be interested to the point of rallying intelligently in support of physicians when the community is threatened by restrictive legislation or attempts to lower the standards of qualifications for practice.

From time to time the most promising efforts in scientific and experimental medicine, indicating results of great value, are interfered with by the efforts of zealous anti-vivisectionists and zoophilists with their attempts at legislative suppression or control of animal experimentation. Had those interested in scientific medicine ever properly informed the public of the nature and object of their experiments, even describing the necessary suffering in the few cases where it must occur, instead of permitting the spread of the general, but unfortunate impression that such practices take place only in cloistered seclusion without systematic method or oversight, no hysterical protests would avail against a community convinced of the great benefits resulting from the labors of those engaged in experimental medicine. The SCIENTIFIC AMERICAN holds no brief for newspaper science, sensationalism, or the commercial exploitation of scientific men and methods, but it does protest against any policy that prevents the result of any scientific investigation, medical or otherwise, being kept from the general discussion of people of intelligence in the columns of journals whose responsible editors make every effort to secure accuracy, authenticity, and sanity for their articles. American medical men must learn that only by the widest knowledge of their efforts and work can they gain the public esteem, while it is only through such knowledge that the higher standards they aim at will be not only appreciated, but generally demanded and enforced.

A Notice

FROM time to time we have had occasion to call attention to the fact that the SCIENTIFIC AMERICAN is not connected in any *way* with the organization entitled, the "Scientific American Compiling Department," engaged in the sale of the Encyclopedia Americana. This notice is published owing to the fact that we frequently receive letters of inquiry in regard to that enterprise, in spite of the notices published in our columns from time to time stating that we are not responsible *for any* statements that may be made by the above-mentioned company or its *alter ego*, the Americana Company. The history of the case and of the long-drawn-out lawsuit in connection with the matter were explained at some length in the SCIENTIFIC AMERICAN of November 8th, 1913. It is because of the continued use of the name contrary to our wish that we feel constrained to again advise our friends and readers of these facts.

German Machinery Imports and Exports for the Last Year.—During 1913 the machinery importation into Germany from all nations totaled about [illegible] tons, divided as to the principal countries as follows: United States, 40 per cent; Great Britain, 24 per cent; [illegible], 7 per cent; Switzerland, 6 per cent, etc. There were imported [illegible] tons of agricultural machinery, representing 44 per cent; 7,500 tons of [illegible] boilers, [illegible] tons of railway and street cars [illegible] and [illegible] tons of motor vehicles.

[illegible]

L[illegible].—[illegible] to [illegible] railway [illegible] New Zealand [illegible] 126 miles in length. [illegible] of its mountainous character, New Zealand is known to be one of the most difficult countries for the construction of railways. Its lines are full of sharp curves and unusually heavy grades.

Preliminary Trial Trip of "Vaterland."—On her first sea test, which lasted for two days, the new Hamburg-American liner "Vaterland" of 58,000 tons, the largest ship in the world, is reported to have made the high average speed of 25.8 knots per hour, with the high output of 90,000 horse-power from her four turbines. Both her owners and her builders, Messrs. Blohm and Voss, are to be congratulated that the ship has so greatly exceeded her contract speed.

Japanese Dreadnought "Fuso."—If the *Marine Rundschau* is correct in stating that the Japanese superdreadnought "Fuso" was recently launched with her engines and guns in place, it seems likely that the Japanese navy will be the first to have a battleship in commission carrying twelve 14-inch guns. This ship is of about 30,000 tons displacement, and she will have a secondary battery of sixteen 6-inch rapid fire guns. She is down for completion in July, 1915, and a sister ship, also building in Japan, is due to be completed a year later.

Population and Traffic Problem.—Great as is the scale upon which the New York subways are being enlarged, it must be admitted that the recent census statistics indicate that the system will be in urgent demand long before it is finished. Figures given out recently from the census office show that on July 1st of this year New York's population will be about 5,333,537 people, which represents a gain in four years of 556,664. This means that the city, large as it is, is now adding to its numbers every year some 140,000 souls, which is the population of a large city.

Hydraulic Grader for Culebra Cut.—A hydraulic grader for smoothing down the slopes of the Culebra Cut has been constructed for the Isthmian Canal Commission. The grader is an arrangement of high-pressure boilers and pumps, which will pump water from alongside the vessel and deliver it at high pressure to pipe lines or hose for sluicing material down at the banks of the canal. This is the kind of work that is being done at Cucuracha slide by pipe-line suction dredge No. 82, which is pumping to two monitors at a discharge pressure of 45 to 50 pounds. The new graders will deliver at a pressure of 225 to 235 pounds to the square inch, discharging through a three-inch hose at an elevation of 50 feet above the water-line.

Large Turbine Air Compressors.—By utilising the energy of rapidly-rotating bladed wheels it is now possible to compress air on the turbine principle to much better advantage, it is claimed, than with piston machines. The rotary type, such as is constructed at the Berlin Allgemeine Works, now goes as high as 3,000,000 cubic feet an hour and compresses to 10 or 12 atmospheres, taking about 12,000 horse-power in a single machine. A special steam turbine is coupled to three separate rotary air compressors. Between each compressor is a cooler for lowering the temperature of the air. The Victoria Falls and Transvaal Power Company appears to be the first to take advantage of the large-unit construction afforded by the present type, and is installing a large plant for power transmission by compressed air, having already in the central station near Johannesburg as many as 12 turbo-compressors of 4,000 horse-power size. Air is sent in 20 miles of pipe to 17 mines for drills and other uses. With the three new 12,000 horse-power sets which are to be put in, the total will be 84,000 horse-power transmitted to the mines.

City Takes Title to Steinway Tube.—Title to the Steinway tunnel, which has been the source of much litigation for years, passed to the city recently. The deed was received by the Mayor from the Interborough Rapid Transit Company, which acquired it some years ago through the absorption of the company owning it. The litigation was as to whether, the franchise for the tunnel having expired, the company would be able to operate it by reason of special legislation. The city won and the company decided to turn the tube over to the city for [illegible]. The cost was in the neighborhood of [illegible]. The tunnel is to be a part of the dual rapid transit system, and the Interborough will be credited with [illegible] as its share in its [illegible] in the entire system. The Board of Estimate approved the contract with the Rapid Transit Construction Company for the completion of the [illegible] pending the completion of [illegible] work will be started soon. The [illegible] Grand Central Station [illegible] in Long Island City.

Electricity

Wireless Telephony from Brussels to Paris.—The London *Times* reports that on March 29th a tenor singing in a concert at Laeken, near Brussels, was heard by wireless telephony on the Eiffel Tower, in Paris. The distance between the two places is 225 miles. Use was made in this experiment of a new microphone invented by the Italian engineer Marzi.

A Railway from Limbach to Mittweida is one of the most recent electric lines in Germany, and is designed to connect these industrial towns and also Burgstädt, taking in many smaller localities, so that the present region of Saxony will have better communication than before. The line is 15 miles long and is fed by the Oberlungwitz electric station. An overhead trolley line working at 1,000 volts supplies the cars, each of which carries two motors of 50 horse-power. Freight as well as passengers is carried on the trains, and there is already a good traffic assured. It makes connection with the state railroad which crosses the electric line at two points.

A Novel Advertising Device has made its appearance, which consists of a polished metal cylinder shaped like a vase. Inside the receptacle is a small electric motor which makes a magnet turn about a shaft. Small articles for sale with pieces of iron imbedded in them are put on the cylinder, and the magnet causes them to travel around the surface. This movement attracts the attention of the passers-by, and still further attraction is caused by employing small figures of men or others of an amusing character which go through irregular evolutions around the cylinder. Small steel balls with flags stuck in them are found among the best for this use.

Electrical Iron and Steel Production in Sweden has been on the increase within a recent period. As to the amount turned out in that country, starting with 122 tons in 1908, it rose to 870 tons in 1910 and 18,000 tons in 1912, or the last report. There are upwards of 20 electric furnaces running at present, using in all some 60,000 horse-power. New furnaces are building at Lofoten, Gelivara and Sandviken. The Stora Kopparberga Company recently purchased a waterfall which gives 150,000 horse-power, and is to build new furnaces in the near future. As regards chrome steel, a new plant was put in use not long ago at Trolhattan with two electric furnaces, which reduce ore imported from New Caledonia and South Africa, using the three-phase system. The product contains from 5 to 9 per cent chromium, and is furnished in four different grades.

The Failure of "Hail-Rods" in France.—Reference has been made several times in these columns to the recent erection in many parts of France of large lightning-rods, known as "electric Niagaras," supposed to be efficacious in averting hailstorms. The futility of such devices seems obvious to persons familiar with the mechanism of thunderstorms, of which hail is merely a by-product, yet hundreds of the rods have been installed at great expense. In a recent communication to the National Society of Agriculture of France, Prof. Alfred Angot, director of the French meteorological service, after pointing out the absurdity of the "Niagaras" from a scientific point of view, cited a number of instances in which the rods had signally failed of their purpose. Thus, the large rod installed on the Eiffel Tower has not had any effect on the frequency of hail in its vicinity. In the suburbs of Clermont-Ferrand a big "Niagara" stands on an iron tower 100 feet high. This rod was itself pelted with hail twice in 1912 and four times in 1913; in one storm some of the hailstones attained the size of hen's eggs. Similar cases have been reported from other parts of France.

Electric Automaton.—M. Torres Quevedo, a well-known Spanish engineer, is occupied with some very interesting inventions in the new government mechanical laboratory at Madrid, of which he is the head. His idea is to be able to operate various kinds of machines on the automatic principle and to a much greater extent than is done at present, largely by the use of electricity, and thus the machine is to do without the workman in numerous cases. It is commonly supposed that an automatic machine must do the allotted work in exactly the same way, but the object proposed by the inventor is to make a machine imitate a human being in carrying out complicated operations implying a choice, where the circumstances in the case are very numerous. To demonstrate this by a special case, he has already constructed an automatic chess player which is reduced to simple terms and makes use of two pieces, while the opponent uses one piece and can move at will. The machine in turn determines the proper move, and carries it out by the mechanism, so that the machine is obliged to provide for a very great choice in making its movements. Another interesting apparatus is an automatic calculator, and, unlike most machines of this class, it is first set at the required figures and then carries out all the needed movements for making the calculation without any manual aid. M. Torres Quevedo is engaged upon a device of this kind, and has already made working models to demonstrate the principles involved.

Science

A Fluorescent Microscope.—Mr. Karl Reichert of Vienna, has constructed a fluorescent microscope which is of advantage in certain cases. The lighting of the object to be observed is effected by provoking its fluorescence by means of ultra-violet rays. The ultra-violet rays, having passed through one of the new light filters of Wood, are concentrated by a quartz lens on the object to be examined. The advantage of this method is that the color of the fluorescent light provoked by the action of the ultra-violet rays varies in general with the chemical nature of the fluorescent object. In this way it is possible to recognize differences in the matter and composition of objects which are not perceptible by ordinary light. It also enables the physiological action of ultra-violet light on living organisms to be studied.

Ocean Temperatures and Icebergs.—The Bureau of Standards has recently issued a bulletin by C. W. Waidner, H. C. Dickinson and J. J. Crowe, on "Observations on Ocean Temperatures in the Vicinity of Icebergs and in Other Parts of the Ocean." The records of sea-water temperatures obtained by means of an electrical resistance thermometer and a Leeds and Northrup temperature recorder installed on the U. S. steamships "Chester" and "Birmingham" in their patrol of the North Atlantic Ocean show that the temperature variations in parts of the ocean far removed from ice are often as great as in the neighborhood of icebergs. This disagrees with the observations of Prof. Barnes. "In view of the differences in the character of the records obtained by Barnes and ourselves," the authors state, "it is very desirable that further observations be made in different parts of the ocean, and under as varied conditions as possible before attempting to draw final conclusions."

The Imperial Bureau of Entomology, conducted under the auspices of the British Colonial Office, is becoming one of the great humanitarian institutions of the British Empire, especially on account of its work in connection with disease-carrying insects. All the British colonies contribute to the expense of the Bureau's work and share in its benefits. During the year 1913 one task carried out was the collecting and collating of the laws and regulations relating to injurious insects in force in the various parts of the Empire. During the same year, 80,000 specimens of insects were received by the Bureau, *of which 14,000 were blood-sucking insects*. An urgent problem now impending is to safeguard India from the importation of the yellow fever mosquito; a contingency threatened by the shifting of trade routes that will follow the opening of the Panama Canal. It is believed that yellow fever has already appeared in New Caledonia. A careful mosquito survey has just been carried out in Hong Kong.

Radium in the Upper Atmosphere.—Hess, of the Vienna Radium Institute, has recently published the results of some remarkable experiments. He has investigated the penetrating radiation which occurs in the upper atmosphere by means of balloon ascents, and he arrives at the startling conclusion that at a height exceeding 2,000 meters there is a rapid increase in the intensity of the penetrating rays. At these heights the penetrating rays from the earth itself would be absolutely negligible, while that from the radium emanation in the air, which has its origin in the earth and is of limited life, must be, at any rate, less than at the surface. So that it would seem we must assume some extra-terrestrial source for these radiations. The conclusion that a great part of the penetrating radiation cannot come from the known radio-active constituents of the earth and atmosphere is one that must evoke general interest, and calls for the further radio-active exploration of the upper atmosphere.

The Electron as a Vibrating Particle.—Herr Korn has established, during a period of over twelve years, a mechanical theory of gravity and of reciprocal molecular effects, the main points of the theory being as follows: Suppose an infinite and incompressible medium, with very rapid vibrations, containing slightly compressible particles; such a system is capable of an infinite number of different vibrations. The mathematical investigation of such a system is not difficult, provided that we assume no whirlpools to exist. The fundamental vibration will be a pulsation of the particles and Newton's Law of Gravitation will express the reciprocal effects of these particles, due to this fundamental vibration. If we impose on the vibrating particles the condition of constant velocity of pulsation, the electrons may be considered as such pulsating particles. In other words, we must conceive the electrons to oppose a very great resistance to any external action tending to modify their velocity of pulsation; it is also necessary to admit that these extremely rapid vibrations emit very little or no radiation. The duration of the vibrations is extremely great in comparison to the duration of all vibrations hitherto known.

Some Interesting Automobile Novelties

A Funeral Motor Car

A SAN FRANCISCO undertaker has built a funeral car that is far more than a hearse, for, in addition to the space for the casket and flowers, there are accommodations for thirty-seven people.

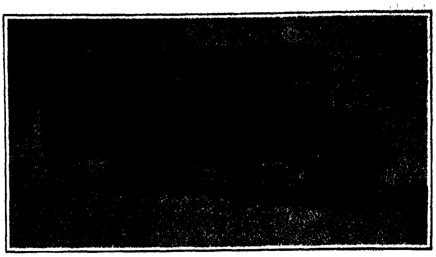
A single vehicle, therefore, may take the place of a whole funeral train. The car is built on a five-ton standard truck chassis. The woodwork is solid mahogany and it is upholstered with 8-inch morocco leather cushions. It is fitted with electric lights and fans, and rivals a parlor car in comfort and elegance. The car is 30 feet long, 10 feet wide, and 18 feet high. In order that it may be able to make the sharp turns in the aisles of the cemeteries, the wheels are cut under.

The Army Automobile in Service

AN armored automobile was lately given some actual work in operations in Morocco, this belonging to the Spanish army. The present car is provided with an especially thick plating, and it covers the whole of a large power car so as to give it the appearance of a square van. Steel plate is used which is said to be proof against usual bullets. The new car is a veritable traveling fortress, and is divided into three parts, the front for the driver, the middle part, which contains the firing outfit and has slit windows with flaps, and the back portion, fitted out as an ammunition hold. On the top of the car are double flap doors which open nearly the entire roof in order to give an outlook, and there are small side windows also placed near the roof for lookout purposes. The main lookout window is in the front end of the car, and above the driver's seat.

The Auto Skiff

FROM the very earliest days of boat building it was realized that the body of a vessel must be shaped to cut through the water readily; but with the design of vehicles on land little thought was given to air resistance until very recently, when our high-speed machines have shown us that air resistance is an important factor. We are beginning to realize that fuel costs may be kept down if our automobiles are designed to plow through the air with a minimum of head and skin friction. More attention has been paid to this abroad than in this country. Automobile bodies are growing more and more like boats Logically, the smaller the engine the more necessary it is to pay attention to streamlines in the car body. The accompanying photograph shows a small foreign car which is so boatlike that it even carries a short mast and flag at the stern Great care has been taken to maintain the lines of the body undisturbed. The steps are kept wholly unencumbered. The tool chest and extra shoes and tires are inclosed in a compartment in the rear. With the motor mounted directly above the single front wheel, weight is reduced to a minimum, and the car is capable of attaining very high speed



Funeral motor car with compartment for the casket and seats for 37 passengers.

Interior of the car, showing the mourners' section.

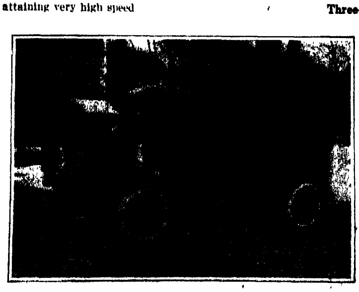
Three-wheeled motor car with boat-shaped body.

A Small Diesel Engine

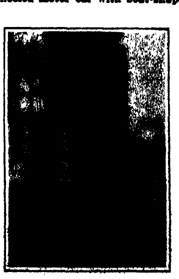
NUMEROUS attempts have been made to produce an oil engine on the Diesel principle, but of small size, such as is demanded for common use, especially for small dynamo groups, but up to the present time the problem seemed to be unsolved. While it is true that the gasoline motor has come into good use for this purpose, its application is limited owing to the cost of fuel, and also danger from fire. Another type of motor using the incandescent tube ignition operates on the same economical fuel as the Diesel engine, but it consumes much more fuel, and the engine is larger and heavier than the Diesel, besides having other disadvantages. Recently the well-known Berlin Allgemeine works has produced a small motor for use with dynamos, ranging from 60 to 200 horse-power sizes. Economy in fuel consumption, good governing within wide limits, and excellent combustion, as shown by the quality of exhaust gas, is secured in the new engine when using a compression of 30 to 40 atmospheres. It employs a special air compressor which furnishes 60 atmospheres for the motor starting and for injecting of combustible. An oil pump supplies the proper quantities of oil at each interval, working in connection with an atomising valve. Another point is the starting by means of compressed air. All the parts are designed so as to be easily operated by ordinary personnel. Small groups of this kind have an all-inclosed dynamo mounted on one side of the motor, and this gives a compact makeup. Compressed air comes from a small pump on the motor, and air is stored up in a cylinder in the base, the oil tank being also lodged here. The present engines run at 500 revolutions per minute. On the whole the present makeup is likely to give a wider scope for the use of the Diesel engine, especially for electric groups.

Motor Car for Transporting Horses

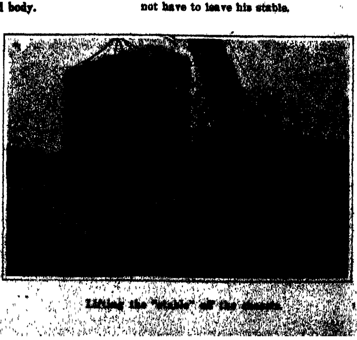
EDMOND BLANC of Monaco, a well-known sportsman, has found that his horses suffered on the journey from the stables in England to the Riviera and return, because of the frequent transfer from railway car to boat, and from boat to car. This had the effect of rendering them nervous, and their performances at the race track were not up to par. The necessity of devising some means of transporting the animals without changing cars was evident. This led to the design of the portable stable shown in the accompanying photograph. It consists of a motor truck body, which may be lifted off the chassis and put aboard a train or a boat as the case may be, without disturbing the horse inside. The interior of the car, as shown in one of the photographs, is well padded inside to protect the horse against injury, and the sides are fitted with shutters to provide ventilation. The horse does not feel the fatigue of travel so long as he does not have to leave his stable.



Motor car for transporting horses.



Padded interior of the car.

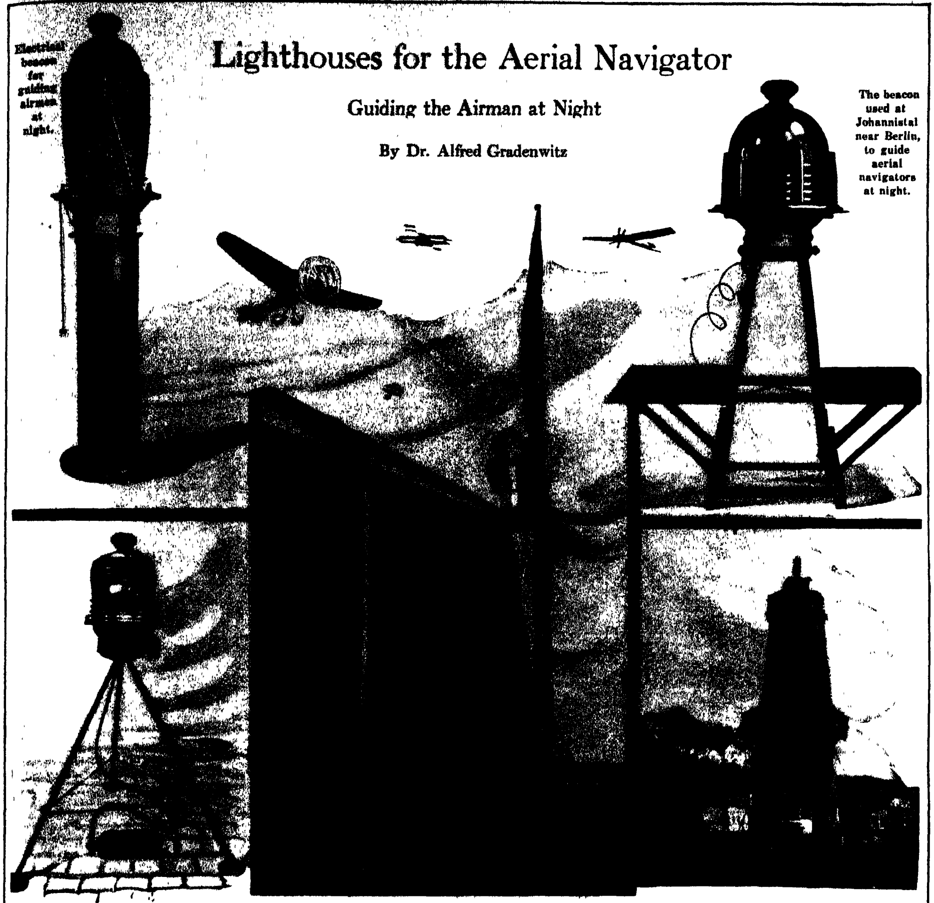


Lifting the "stable" off the chassis.

Lighthouses for the Aerial Navigator

Guiding the Airman at Night

By Dr. Alfred Gradenwitz



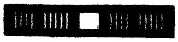
Electrical beacon for guiding airmen at night.

The beacon used at Johannistal near Berlin, to guide aerial navigators at night.

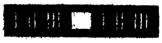
Portable military gas beacon.

The beacon used at Potsdam.

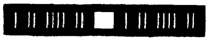
A lighthouse for the Johannistal airmen.



Light signal known as mark 45.



Light signal known as mark 123.



Light signal known as mark 1242.

THE use of fires to inform the navigator at dark and in foggy weather of the proximity of the coast and of his actual position can be dated back to the days of Grecian antiquity. In ancient times torches were lighted or heaps of logs burnt, but our inventive age has produced beacons in which the rays from various sources of light are reinforced by mirrors and lenses. These beacons, in accordance with the rapid strides made by navigation, have lately been developed to extraordinary perfection and variety.

The airman requires a similar means to find his way in the atmospheric ocean as navigators at sea. Whereas the light from beacons in the sea need be seen only in a practically horizontal direction, lights for aerial navigation must so give out their beams as to be visible from any point of space situated above the lowest flying level.

A Berlin firm has for some years been engaged in experimental work destined to produce special types of searchlight for aerial navigation. The first type of aerial beacon which they evolved was a stationary apparatus radiating freely in an upward direction beams of light coming from the upper hemisphere, whereas the beams from the lower hemisphere were deflected in a practically horizontal direction by a set of prisms. The type eventually developed, however, comprises several belts of lenses, sending out uniformly in all directions the beams of a lamp placed in the focus.

A point was made from the outset so to design these intermittent beacons as to allow each place to be distinguished from any other by some characteristic mark. Each aerial beacon must have a distinctive mark of its own, this being the only means of reducing the risk of the aeronaut's losing his way. Such marks are made up of variable successions of light flashes denoting given figures.

These characteristic flashes enable the aeronaut with the aid of his log-book, at a moment's notice to ascertain the place where the beacon is situated. Other methods of characterising the place, e. g., by a sequence of long and short flashes, in accordance with the Morse alphabet, or by multicolored lanterns, would not seem to be desirable. In fact, the use of the Morse signs would presuppose a perfect familiarity with the Morse alphabet, and the adoption of colored lights would be impracticable on account of the considerable reduction in luminous intensity due to the insertion of colored glasses.

The aerial beacons here illustrated are designed to emit an unlimited sequence of flashes of sufficient luminous intensity. Electric incandescent lamps or gas (e. g., acetylene or Blau gas) lanterns are used as sources of light. One of our pictures shows an electric searchlight comprising special lamps (of up to 50,000 candlepower) surrounded by a lens system which is so designed that the beams of light in clear weather are visible up to 40 kilometers as a minimum. A glass globe covers the lenses on the top, a discharge hood serving to prevent excessive heating in the interior of the lamp.

The distinctive flashes previously referred to are produced by a special switch In flashing the beacons for aerial navigation, the end signal is of great importance. While marking flashes of one and one half seconds as a maximum have been found to be absolutely sufficient, a light of about five seconds' duration is desirable for the end signal.

Wherever electrical energy is available, the use of electric searchlights will be found preferable, whereas on mountain tops and close to the seacoast, where there is no supply of electricity, gas-operated beacons are used to advantage.

Rotating beacons have also been constructed, which combine the beams of light in a bundle seen as a narrow luminous band reaching from the horizon to the zenith. In order to be seen from all points of space, this band must be given a rotation round its axis Since the whole radiation given out from the lamp is crowded into a relatively small space, the luminous intensity of rotary searchlights is much greater than that of belt-lens beacons, and may amount to many millions of candle-power.

These searchlights will not only warrant a safe flight to the airman's destination on the shortest possible way, but will prevent his crossing the frontier or the seacoast

Has the Fighting Dirigible Airship Arrived?

By Carl Dienstbach

THE veil has at last been lifted from some of the German army and navy preparations for real war in the air. It appears that the largest type of dirigible is now actually at that stage of its development in which its importance as a long range scout is well nigh equaled by its ability to fight. Far from showing its nose only where none of the dreaded armed aeroplanes are at large, its actual rôle in the battles of the future may well be expected to consist in blocking the air to aeroplanes just where free passage would be indispensable for efficient scouting.

The dirigible's comparative slowness would no more prevent it from protecting the secrets of a locality than, for instance, the comparative slowness of dreadnoughts would prevent them from protecting a sluggish fleet of transports against the torpedoes of swift destroyers.

Keeping the "inner circle" and able to perceive the approach of aeroplanes at a score of miles distance, it would need no racing speed to intercept them from any angle with a fire that has now actually been proved efficient at 2,000 yards.

"Vibration" and the lighter machine's quickened "period of oscillation" is the shibboleth that spells the superiority of the dirigible's fire. On a swaying aeroplane this has been compared with the jerking of an automobile over an ordinary road. A designer of machine guns and one-time champion revolver shot once told the writer that after having been up in both monoplanes and biplanes, only automatic pistols fired from the hand could be used to advantage This may be exaggerated, but it is the writer's own experience that in the cabin of a Zeppelin no vibration exists The slow swaying is imperceptible. The aeroplane, especially the fast light type, is essentially all engine room, and as long as its motor is turning there is vibration. Heavier machines, while less jerky in balancing, generally lose much of the advantage of speed. Machine guns have been fired from aeroplanes, but no great results are on record. Small dirigibles, with everything crowded into a car, would vibrate no less. But the results and details of tests made by the very modern war Zeppelin "Z V," on March 12th, at the Doeberitz Military Aerodrome, the first of their kind to become known, are truly remarkable. At a distance of 1,833 yards it scored a large percentage of hits with its machine gun on a target 12 by 33 feet, supported by kites. Even at 2,000 yards hits were recorded.

This was all done with a machine gun of not much greater range than a rifle's. But when Greek meets Greek in the air, when dirigible fights dirigible, larger calibers are inevitable.

It seems impossible that the history of dreadnought development should not repeat itself. In the air as on the water, the final competition will be in the size of gun that may be carried and the speed that can be made at the same time. A 30-knot dreadnought, with enormous "spotting" masts, if carrying only two extraordinarily high-powered rifles, would hardly need much armoring; it would fight at will at a range where it cannot be hit. The same principle underlies aerial fighting; all the more so because the problem, with the great vulnerability of dirigibles and the impossibility of armoring them, reduces itself plainly to hitting at a greater range, preserved by superior speed, both procured by enlarged size.

A specific complication arises from the danger of igniting the gas by the blast from larger pieces. But if care is taken to fire them only while moving at top speed, the rush of air past the muzzles positively prevents ignition by blowing away the gas. Bracing the gun-mounts against recoil offers no insurmountable difficulty, and there is no danger to the equilibrium.

No less reliable an authority than Dr. Eckener is responsible for equally startling recent revelations about the other kind of aerial marksmanship, dropping bombs to the ground, as practised by modern Zeppelins. From a safe altitude of 5,000 feet heavy bombs were dropped within circles marked by buoys on the water of the lower Elbe, of only 15 feet in diameter, showing that they could be dropped as well into the funnels of warships. Tests made on land showed that from an equal elevation a railroad station could be completely wrecked by four of these bombs. Theory has long indicated the feasibility of these performances, if necessary conditions—heavy weight of bomb, steadiness of aircraft, exact knowledge of the vertical direction, of the distance from the ground, and of the speed over the ground —are complied with. A Zeppelin furnishes all facilities for fulfilling these conditions.

The armament of a war Zeppelin actually includes one piece of heavier artillery in addition to the machine gun. The caliber seems to be little above two inches, to judge from the ranges reported, according to late reports. The target was a box 30 by 15 feet, suspended 1,000 feet above the ground from one of the military captive "kite" balloons. Near the center of both its longest surfaces there were "bull's eyes," black marks corresponding in size with the motor and the pilot of an aeroplane. From an elevation of 1,900 to 2,100 feet the "ZV," at the second trial of 15 rounds from its heavier cannon, hit both of these marks at a range of 2,100 yards, although the target was blown about like a leaf in the strong wind. While firing, the airship circled about the target. At the first trial, also with a total of 15 rounds, both the machine gun and the cannon were very efficient at a distance of 1,600 yards. In the third trial the range was increased to 2,600 yards, again only the cannon being used. The guns are both carried on a platform on top of the hull, and are removed from the proximity of escaping gas.

On March 30th the "Z V" gave a demonstration over Berlin, which puts a sinister meaning to Dr. Eckener's statements. She directly followed the "Hansa," which had traversed the city with the usual hum of the motors, but in silence. The motors of the Zeppelin of to-day are muffled as efficiently as those of the best automobiles, and it has been found that the propellers alone, at any height, escape detection. In very cloudy weather or at night the presence of a deadly airship within easy striking distance may never be suspected. No wonder that Dr. Eckener stated in the same lecture that the perfectly feasible regular airship service to British ports, to catch the "Lusitania" and considerably shorten the trip from Germany to the United States, in the absence of an adequate English air navy, was as yet out of the question for reasons of international politics.

After the new Zeppelin "Z VIII," on March 29th, ascended to 10,000 feet, even the upper air can hardly be considered a safe refuge for the aeroplane.

A protecting airship, cruising above a limited zone, needs only a minimum amount of fuel (easily renewed), and, thus lightened, climbs readily. Correct observations, difficult at best from a high altitude, are hardly helped by the excitement of being attacked, even if the aeroplane escapes destruction.

Wit and Humor Cannot Be Appreciated Without Muscular Movements

By Dr. Leonard Keene Hirshberg, A.B., M.A., M.D. (Johns Hopkins)

WALTER SHANDY, the world's greatest reasoner—he confesses it himself—was master of one of the finest chains of sublimate humor, yet for the life of him he was unable to get one line of it into the head of his wife. Mr. Strickland Gillilan says it's the simplest thing in the world to write a joke. All you have to do is sit down, strike the keys of your typewriter, and there you are. Only you must think of one first. That's where the difficulty arises.

What the subdivisions of humor may be, whether wit, fun, laughter, humor and word-play, are one and the same thing, or all different, is after all not material to an analysis of the question. To arrive truly at the fundamental element of the emotion which arises from the fifty-seven varieties of fun, known under the broad terms jest, wit, jokes, humor, fun and laughter, I selected three recent numbers of *Life*, *Puck*, and *Judge*, and submitted these to twenty individuals of average intelligence to say whether the various pictures, anecdotes, and jokes were or were not funny, and why.

One of the pictures that excited the risibilities of the subjects, was that of a little fellow who had eaten green apples. He was pictured all bent-up with his hands pressed into his little tummy. To a sympathetic mother, he said: "Mamma, I feel like a thunder-storm is inside me." Two who examined this, said: "Poor little fellow, no wonder he feels like a thunder-storm." The others all considered the incongruous rumbling of the stomach as recalling the rolling to be the crux of their interest.

The picture of a young girl sitting on a bench around whose waist were the arms of two young men, was among those shown. The legend, "A Divided Skirt," was printed beneath. One saw the humor in this with "moving eyes," as a "play upon the word *skirt*, vulgarly known as a girl, the tender element of attraction between the sexes, and the composite pleasure of discerning the hidden meaning of the word as well as the present funny vogue of that kind of wearing apparel."

While none of them overtly laughed or smiled, all admitted that the enjoyment or other emotions were accompanied with inclinations to move their facial muscles, or an imaginary movement of those muscles.

An elaborate drawing-room, with husband bending forward intently to his wife, explained this dialogue: "Wifey, will you shed any tears when I die?" The wife, a retired emotional actress, replied: "It is so long since I shed a bushel or two of them, and I am so out of practice, I cannot say," was so far from humorous to the ten women that they [illegible] as "degrading [illegible] men all considered it funny, [illegible] unmasked, because the husband [illegible]," "quibble," "sentimental" and "[illegible]."

Another illustration of five little [illegible] looking out of a window under which was the sign "Angels Rest Nursery," struck all the [illegible] as "cute," "sweet," "pretty," "pleasant," "[illegible]," and the like. They said they were inclined to smile, that is, to inhibit or reprove a tender muscular movement of the face. In a word, this picture of *Judge* was considered as in a tender key of pathos, rather than incongruity, awkwardness, or funny, false position.

A disheveled gentleman, with his cravat and collar awry, picking himself up from the bottommost step of a long flight, was shown, with this line beneath the two words, "An Optimist": "Oh, well, I was coming down, anyway."

All of the subjects maintained that this was uproariously funny, because (1) "to obscure his embarrassment, the man offered an unbelievable excuse," (2) "because he was awkward, yet unmindful of his degraded, incongruous position," (3) "there was no one around to accept a flimsy reason for his serious, yet clumsy predicament," (4) "his mechanical and unconscious position of awkwardness and impossible explanation," (5) "absurd attempt to divert attention from his inefficient faux pas," (6) "undignified and unexpected reversal of form," (7) "interruption of smooth and even tenor of one's way by an abrupt but not unhappy catastrophe." And so on. In a word, surprise, abrupt termination of smooth sailing thought, embarrassment, lame excuse, double meaning, incongruity, debasement of a neutral or unfriendly person, awkwardness, and mock reasoning were all offered as evidence of the muscular facial contortions that presented this picture as uproariously funny.

Thus it is seen that at the bottom, the stimulus that gives rise to the emotions grouped under the names of humor and pity really causes muscular movements first. These produce the mental states known as pathos, wit, and cuteness. Proof of this discovery is found in the fact that persons whose facial muscles are absolutely paralyzed cannot see a joke. Stolid-faced Englishmen, as well as persons whose cheeks and mouth-muscles are seriously burned or scarred-up, fail to see the points of definite and open jests. On the other hand, the rough, muscular, active movements of slap-stick comedy acts on the vaudeville stage are even funny to paralytics and idiots. For, the observer really laughs at such gyrations by way of his neck, head, belly, and arm muscles. In a word, the coarser the fun, the larger are the muscles that laugh. Even the man in the iron mask can enjoy a practical joke that will make a horse laugh.

The Flight of the House Fly

AT a meeting of the Cambridge Philosophical Society, Dr. E. Hindle described some experiments which he made with G. Merriman in order to determine the housefly's range of flight. During the course of the experiments about 25,000 flies were released under various conditions of weather and temperature. No less than fifty observing stations were arranged where the flies were caught in traps or on flypaper. In order to identify them they had been dusted with red or yellow chalk powder. The experiments showed that the flies winged their way either directly against the wind or obliquely to it. This phenomenon has also been observed in the case of other insects as well as of birds. The greatest distance covered by a fly was 700 meters, and a large part of this lay over open ground. In densely crowded cities, Dr. Hindle does not believe that the fly travels more than 400 meters. In order to secure the widest distribution, fine weather and warmth are necessary. Flies which were released in the afternoon, were not so widely distributed as flies which were released in the morning.

The Structure of Crystals

IN a paper before the Royal Society of London W. L. Bragg investigates the structure of some crystalline bodies, as indicated by the manner in which they diffract X-rays. For a certain number of simple crystals it is found that the interference figures may be attributed to the diffraction of a "white" radiation by a series of points situated on a configuration in space. Each of these points is a simple atom; if an atom, in a molecule, is at least twice as heavy as any one of the others, it is the configuration formed by these atoms which reveals the figure of diffraction. Two atoms of approximately the same atomic weight are nearly equal as centers of diffraction. The lightest atoms of the molecule are not grouped in the immediate neighborhood of the heavy atoms, but occupy intermediate positions. Thus, in chloride of sodium, the sodium atom has six neighboring atoms of chlorine equally near with which it can combine to form a molecule of NaCl. In some cases the atoms are arranged in a [illegible] in such a way that layers parallel to the [illegible] contain alternate atoms of each species.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Wireless Distress Signals

To the Editor of the SCIENTIFIC AMERICAN:

Newspaper reports of the false "S O S" supposed to have been sent by the "Siberia," unfortunately place this single exceptional instance in a light which, in the public mind, may offset a thousand correctly transmitted signal messages. Inasmuch as the signals S O S (s · · ·, o — — —, s · · ·) are quite dissimilar from M B S (m — —, b — · · ·, s · · ·) it seems evident that the confusion is due to the gross carelessness of the operator rather than the apparatus employed. If the signals had been H O S or I O S the excuse might have appeared more plausible, for the resemblance would have been closer.

In a pending patent the writer has proposed to prevent such serious confusion by assigning a definite tone combination which is to be used only for distress signaling, a signal which cannot be mistaken for static or other ship calls—even by a novice. The plan has been satisfactorily tested. If such a tone combination can be universally agreed upon and adopted for exclusive use in distress signaling confusion will be obviated. An ordinary seaman can tell the difference between such a distress signal and all other, where a partially trained operator may fail to pick out the present distress signal with certainty. According to this plan the distress signal will be analogous to the Klaxon horn, and its use should leave no doubt at the receiving station.

Even if this plan is not subsequently adopted the writer would suggest that the present distress signal can be made more efficient by

1. Requiring that it be sent by a musical pitch transmitter, or its equivalent, so that it can be distinguished from static X's. This means that open spark sets must be remodeled or replaced by more modern equipment.

2. Instructing all operators to give the dashes of the O full value, or more than full value (—— —— ——; not — — —), to distinguish from the dots of the two S's. A FULL space interval should also be allowed between each signal group so that the apparent running over of signals is prevented.

As matters stand, there ought to be an investigation to ascertain why the "Siberia" did not hear the false relayed radio reports and stop them. Although radio communication is far from perfect, and it should be remembered that the ordinary telegraph and telephone are imperfect, it has certainly advanced to a point where it is practical and normally reliable.

Minneapolis, Minn. PHILIP E. EDELMAN.

The Rhinoceros Beetle

To the Editor of the SCIENTIFIC AMERICAN:

Since the publication of my article concerning Dr. Friederichs' discovery of a wonderful fungus which destroys the larvæ of the well known Rhinoceros beetle, I learn from some correspondence I have had with Manila that Dr. Friederichs has himself found this identical fungus at work in the Philippines.

I quote from an official paper just received from O. W. Barrett, Esq., Chief of Division of Horticulture, Manila: "Dr. Friederichs of Apia has spent about one month here investigating cocoanut pests, and finds the same fungus (*Metarrhizium* (*Chromostylium*) *anisopliæ* (*Metsch*) *Sorokin*) is in evidence here. In fact, it is probable that this fungus has been instrumental in keeping the 'Uang' in check for many years past in the Philippines." H. J. MOORS.

Apia, Samoa.

Modern Naval Ordnance

To the Editor of the SCIENTIFIC AMERICAN:

In No. 6, vol. cx, February 7th, you mention the French 13.4-inch gun: shell, 1,433 pounds; velocity, 2,[illegible] feet. The energy by $\frac{Wv^2}{2g}$ works out equal 70,000 foot-tons, approximately. So this shell is, as you say, somewhat more powerful than our own 14-inch shell. If we take into consideration the very important factor of "ballistic coefficient," it would seem to me that the French gun shows a very considerably higher efficiency, as that factor is approximately as 8 to 7 in comparison with our 14-inch piece. This is shown by formula for ballistic coefficient: $\frac{w}{d^2}$; w = weight of the shell, d = diameter of caliber of gun. The German [illegible] gun, which you mentioned some time ago, with [illegible] of [illegible] pounds, would also look inferior to the French piece in that respect. What the weight of the [illegible] 16-inch gun's projectile is I know not; if it be [illegible] pounds, it would be just about even with the French piece.

Would you kindly discuss these matters in your esteemed publication? REV. J. H. MEYER, S. J.

New Orleans, La.

"Gore-shaped" Harbor Entrance

To the Editor of the SCIENTIFIC AMERICAN:

I am sending you a sketch of what I think is the proper way to construct an entrance to a harbor such as the ones named. I have sent copies to the Minister of Public Works, Ottawa, and to the Honorable the Secretary of the Interior, Washington. There are many harbors on your side of the lakes that are entered between piers, and I am sure a like experience must be had.

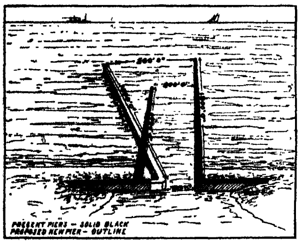
I should very much like to see a harbor entrance constructed as indicated, before I pass in my checks, as I am sure that it will work as claimed.

Owen Sound, Ontario, Canada. E. DUNN.

The letter referred to by our correspondent follows:

"*Sir:* I beg to submit to you a plan of what I think is the proper way to construct a harbor, or rather, the entrance to one, on an open beach, like Goderich or Port Stanley. Both of these harbors are entered between piers. Those of Port Stanley are about 1,000 feet long and 85 feet between them. Those of Goderich are, the south one 1,500 feet and the north one 1,000 feet long and 200 feet between them.

"Where They Fail.—Those of Port Stanley cannot be taken in a gale off the lake. When I was in the Government steamer "Petrel" I many times ran back to Long Point, 60 miles, rather than take the risk, and she was but a small vessel. In this case, however, the piers being so close together there is no sea at the harbor end; but in the case of Goderich, where the piers are 200 feet apart, a heavy sea runs right into the harbor. They have built at the harbor end what they call a check water, which does not always check. I have lain there when the sea has broken over it in a solid mass, when loading or unloading of vessels was impossible. My ideas are the result of my observations of the working of the sea in natural harbors. If you will take a chart of the Georgian Bay, and compare Owen Sound Bay with that of Colpeys, which has three islands off its mouth, you would naturally think there would be less sea at its head, under the same circumstances, than at the head of Owen Sound Bay, but such is not the case. The gore shape of the bay is the cause, it being 7 miles wide at its mouth and tapering to half a mile at the head. Colpey's Bay, on the other hand, is nearly parallel, and whatever sea passes through the gap between White Cloud and Hay Islands, rolls right to the head.



Proposed reconstruction of south pier at entrance to Goderich harbor.

"I have many times run before a storm into Owen Sound, and from the entrance to the head the sea would be quite noticeably less every mile, and at the head not half as high as the head of Colpey's Bay. Gore Bay, on the north side of the Manitoulin Island, gives the same evidence, that is, the shape of the bay kills the sea. I made a miniature harbor and entrance on the same scale as the sketch herewith, and found it worked as I expected."

The Problem of Our Navy

To the Editor of the SCIENTIFIC AMERICAN:

As an old subscriber to the SCIENTIFIC AMERICAN, I have been very greatly interested in the series of articles now being published on the "Problem of Our Navy," and especially in what you say in article IX about educating the public to view this matter in an intelligent manner.

My purpose in writing you this is to call your attention to something which, in my opinion, is doing a great deal to damage the Navy in the interior States. I am a farmer by occupation, and as such I keep several farm papers of the better class, and these are, as a rule, not hostile to Government expenditures on naval and military matters, but there are a great number of cheap farm papers being printed in this country which have a circulation of from 500,000 to 750,000 subscriptions, and about every other issue has in it some article headed "150 Million Dollars for Navy," or "Every Time Navy Fires a Shot the Value of Your Wheat Field or Flock of Chickens Goes Up in Smoke." Now, in my opinion, this is doing a great deal to injure the Navy, as most of these farmers, who comprise a large part of the voters, are living in the interior of the country. Furthermore, I know a great many of these men who read no other papers at all except some country paper which has equally warped opinions. I have just read an article in a large city newspaper headed, "Naval Efficiency," which went on to tell how prompt the Navy was in the Mexican crisis, and how it could have, to use one of their own phrases, "plowed the seas in search of any enemy in twenty-four hours," as though there was no difference between a first-class naval engagement and bombarding a more or less defenseless harbor. KARL F. JUGLER.

Black Pine, Oneida Co., Idaho.

436,682 Tons of Valueless Water Shipped With Corn Each Year

IN several particulars the systems used by United States shippers are far less economical than those employed by foreign shippers, notably in Germany. Food is started on long freight journeys in such condition that heavy freight charges must be paid on elements which have to be taken out of the food at the end of the trip before it can be used as food. One of the heaviest wasted freight items is the freight paid for the transportation of excessive moisture in corn, and in potatoes to be used for stock food or in the manufacture of starch. In Germany the culls and faulty potatoes, which in this country are thrown away, are dried so as to remove all excess water and then shipped to various points for stock feed purposes. This practice of drying potatoes for stock feed and uses in the arts has not gained great headway in this country. As a result the culls commonly are thrown away and starch is made from potatoes only when there are excess crops which make them available at a cheap price which permits of shipment to the factories. Potatoes in their natural state contain upward of 70 per cent of water which has no special nutritive value. Long shipments of potatoes, therefore, in their natural state are not practicable, whereas the Germans who have dried out the excessive water find it practicable to ship the dried product.

The waste water now being shipped in corn in the United States has a serious bearing on the actual cost of corn, and also is one explanation for the great shortage of cars at the corn shipping seasons. The American people are paying freight on 436,682 tons of water in shipping their corn from the producing sections to the market. This means that at a time when there is a great shortage of cars, there is the equivalent of over 14,556 freight cars of 60,000 pounds capacity loaded with water which is responsible for the enormous losses resulting from the deterioration of shelled corn before it is finally consumed. Figuring a car length at forty feet, this means that each year a train 582,240 feet long, or over 110 miles, not counting the locomotives, is engaged in nothing more profitable than hauling water from a few miles up to a thousand miles in the case of corn shipped to the seaboard points from the central corn producing area. Exactly how much excess freight this represents cannot be accurately determined, but as the freight rate on corn is about one cent per ton-mile, it can be seen that this hauling of useless water in corn adds materially to the cost of the product before it reaches the consumer.

Many of the big elevators in the central corn markets now have machinery for drying out excessive moisture. Comparatively few of the smaller collecting elevators have these drying machines, and the only method of drying corn possessed by most producers is storing it properly in cribs. Corn shipped during the summer months, therefore, has had a chance to dry out in the crib, but in the cold and wet months crib drying is not very effective and corn shipped during these months generally has a moisture content above No. 2 grade. Because of the moisture in such corn, few country buyers will buy corn from farmers except as No. 3 or No. 4 grade. If it grades better, the buyer, and not the producer, gets the benefit of the better rating. Under the present system the farmer has no way of determining the actual grade of his corn in his crib, and having brought it to a shipping point could not afford to return it to his bins. There is, however, a movement in communities where co-operative production is being established to inaugurate a system whereby farmers can have their corn graded at the crib and thus determine whether or not they will sell it, before they have hauled it to a shipping point. The question of moisture content and the tremendous waste in freight paid on water that is later dried out of the corn has not heretofore, according to the specialists, received the attention it deserves.

Interesting Features of Cup-defender Construction

Details of Resolute, Vanitie and Defiance

COMPLEMENTING our article and drawings of May 2nd, giving the principal features of the three cup-defending yachts, we present in this issue excellent illustrations of the "Resolute" on her first trial spin, and also some interesting details of the hull and spar construction of the yachts.

It will be noticed that each boat is framed on the system which was first originated, for yacht construction, by Herreshoff in the "Constitution" of the year 1901. As far as we know, previous to that date, reliance upon keeping the hull to shape was placed upon a large number of closely spaced, light, and shallow frames. Now the strength of any member to resist bending in the plane of its depth, others things being equal, is generally proportional to the square of its depth. It was in recognition of this law that Herreshoff, in building the "Constitution," determined to introduce a number of deep, web frames, thereby greatly increasing the stiffness of his hull without making any corresponding increase in the weight of the material used.

When "Constitution" made her appearance it was mistakenly reported that Herreshoff had abandoned transverse framing in favor of a system of longitudinal framing. As a matter of fact, he had increased the stiffness of the transverse framing, and the so-called longitudinal framing consisted of T-irons and bulb angles, introduced, respectively, along the seams of the plating and intermediately between the seams, in order to form the butt joints and to assist in holding the very light hull plating to true form. It is a distinct tribute to the constructive skill of Herreshoff that his two competitors in this season's racing have adopted the principle of construction which distinguished the "Constitution" of twelve years ago.

"RESOLUTE."—There are sixty-two frame stations in the hull of the "Resolute," and on seventeen of these there are web frames, varying in depth from 8 to 12 inches. These frames run entirely around the hull and across the deck. Intermediate between each pair of web frames are three smaller sub-frames, which are carried up well into the bilges, but not above the water line. The six strakes of plating are laid on with flush seams, the edges of the plating being riveted to nickel-steel, 4½- by 4½-inch T-irons, running along the seams, with 3-inch by 2-inch bulb angles running longitudinally midway between the seams. The covering board of the deck is of galvanized steel 7/32 of an inch thick by 18 inches wide. The balance of the deck is covered with aluminium plate 7/32 of an inch thick and 18 inches wide, the deck plates being lapped toward the covering boards. The whole deck is covered with canvas and sanded. The manganese hull plating is 5/32 of an inch in thickness, except the top strake and the garboard strake, which are 7/32 of an inch in thickness. There are six strakes of hull plating, the bottom strake overlapping the lead, to which it is very securely fastened.

Evidently, Herreshoff expects to do some experimenting with his sail plan, for he has provided two mast steps, one 33 inches abaft of the other. Judging from the photograph of the trial spin of "Resolute," it would look as though the footing of the mast was at present on the after step.

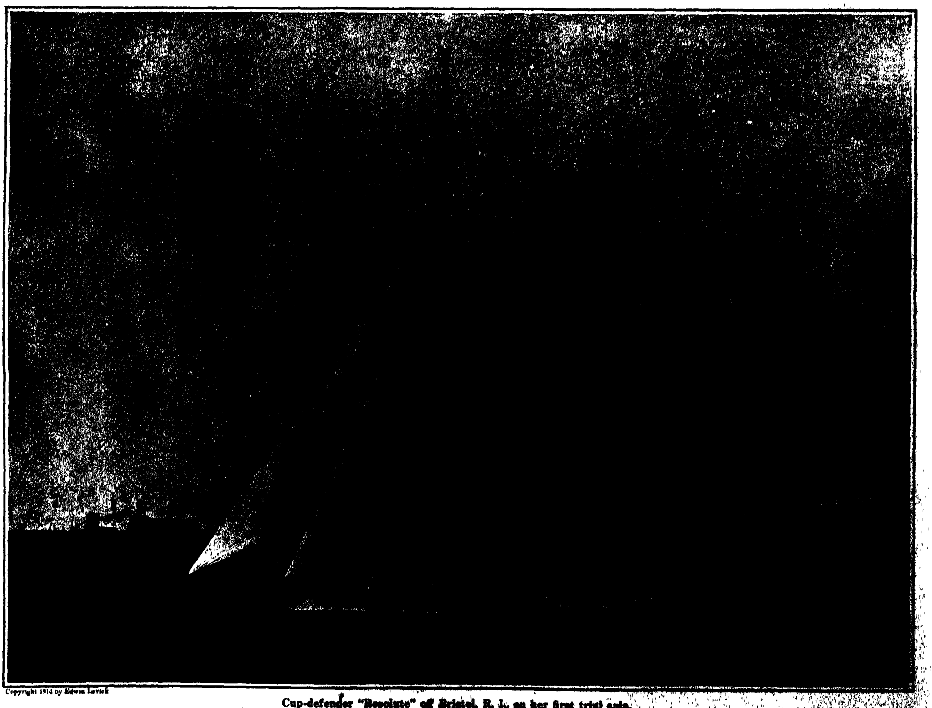
The mast, 20 inches in diameter at the foot, is built of nickel steel, stiffened longitudinally with ten 1 by 1½-inch nickel bulb angles. The foot of the topmast houses within the mainmast, footing upon a hollow steel cone riveted to the shell of the mast, as shown in our drawing. About every 10 feet of the length of the mast there is a steel diaphragm, cut away at its outer periphery to allow the bulb angles to pass through, and lightened by having holes drilled out.

"VANITIE."—An interesting drawing among those showing the construction of "Vanitie" is that of the junction of the framing with the lead. A bronze casting, to the flanges of which the frames are riveted, is attached to the lead by heavy lag-screws—an oak plank being interposed between lead and casting. Two other interesting details are those of the gammon-iron and rudder-post, each of which in a bronze casting. The gammon-iron makes a very neat finish at the stem head; it will be noted that it is recessed to receive the top strake of the plating. The rudder-post sleeve casting is also a neat piece of design. The Gardner boat has the largest centerboard of the three yachts; also, the center of gravity of the lead is lower than that of the other boats, and this, coupled with the harder bilges, would tend to give the "Vanitie" greater sail-carrying power than her competitors. The "Vanitie" has an extremely fine bow, with a very decided hollow—a feature which has marked the latest of Gardner's fast yachts. This designer has always built a very beautiful boat, and "Vanitie" will probably be the most shapely of them all.

"DEFIANCE."—The half midship section of "Defiance" shows very clearly the nature of the webbed frame construction, to which reference has been made above. Owen, her designer, more than either of the others, has cut away every ounce of superfluous material, not only in the web framing, but in every part of the construction from which it could be removed without impairing the structural strength.

The loss of longitudinal bending strength, due to the adoption of a wooden skin in the place of bronze plating, is compensated in the Owen boat by making the seams of the inner and outer skins of wooden sheathing break joints, as shown in one of our drawings. We noted in our previous article that the inner skin of fir is fastened to the framing by bronze bolts, one of which is shown herewith in a *separate sketch*. Attention also is drawn to the bronze screws which pass through the inner skin from the inside and take hold of the 1½-inch outside mahogany skin. The hull will be painted with white enamel paint below the waterline and above the waterline the mahogany will be highly varnished. An interesting detail is the turning up between the transverse frames of the edges of the diagonal strapping of the hull, in order to gain additional stiffness.

The mast construction is generally similar to that of the "Resolute," with the difference that there are six bulb angles of deeper section running the length of the mast in place of the ten shallower bulbs used in the mast of the "Resolute."



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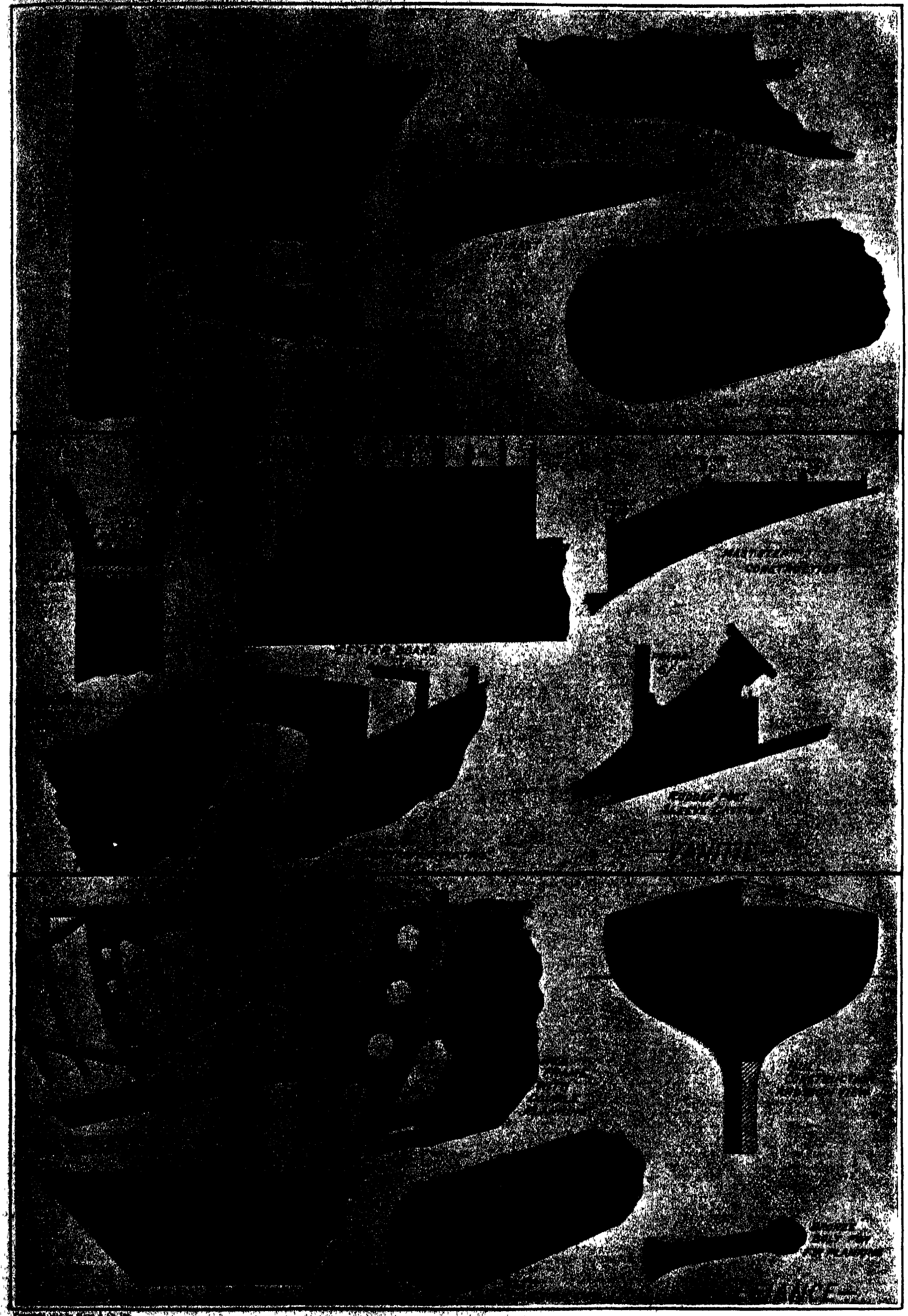
Cup-defender "Resolute" off Bristol, R. I., on her first trial spin.



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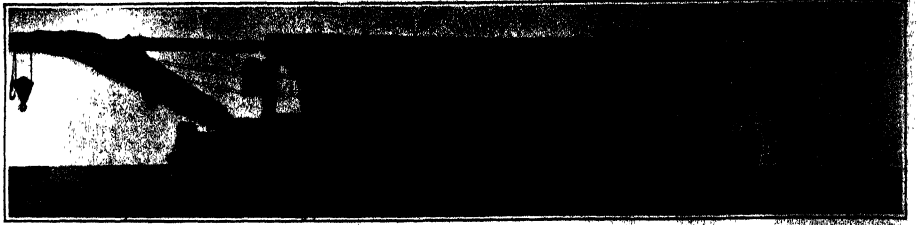
Some interesting details of cup defender construction.



Powerful, electric wrecking crane designed for the underground clearances and conditions of the Grand Central Terminal.

A 100-ton Tunnel Crane

A DOUBLE-END electric wrecking crane with independent hundred-ton capacity cranes at each end, has been received, recently, by the New York Central Railroad for use in case of accidents or wrecks within the electric division of the road. The crane is especially designed for the underground clearances and conditions existing in the Grand Central Terminal, although it may be used also on the main line of the electric division. The machine will be dispatched at high speed under its own power to the scene of the accident.

To design a crane of the large capacity required, under the unusual limitations imposed by the conditions of tunnel operation, was not a simple matter. At the express level head-room for raising the boom and room at the side for slewing were both restricted. Also excessive concentration of wheel loads had to be avoided. The crane had to be designed to perform wrecking operations that are quite different from those found elsewhere.

The procedure in case of a wreck underground will be somewhat as follows: If possible, the wreckage would be lifted clear of the track, and the crane would then back out with it. If, on account of lack of head-room or because of the size of the piece, it could not be raised off the track, one end would be lifted with the main hoist, and with the auxiliary hoist a special truck would be placed under it. The crane would then drag away the load.

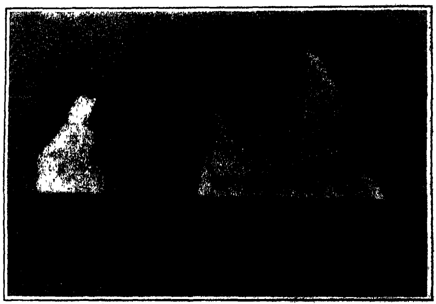
The car body of the crane is 67 feet long with a wheel base of 51 feet, and it is carried on two compound trucks made up of two four-wheel trucks each. A cradle on which the car body rests allows the compound trucks as well as each single truck to have perfect freedom to swing when making turns. There is a comprehensive system of air-operated telescopic outriggers or jack-beams to aid stability during heavy lifting, and to distribute the load over a greater area. The independent cranes at each end of the car have a structural mast and boom, accurately turned roller path and rollers, and slewing mechanism. All of the motions of operation may be performed independently, and with loads up to the capacities of the motors may be performed simultaneously. All the clutches are operated pneumatically to insure quick and sure engagement and release. Four 200 horse-power motors are used for propelling the machine, and two of 150 horse-power each for hoisting and for operating machinery. The propelling motors are controlled from each end of the car, and all four may be used for traveling, or, if desired, only the two at either end. They are capable of operating safely on fluctuations of line voltage between 300 and 750 volts, direct current. For intermittent and emergency service, as might be required with the third rail out of commission, or when suitable cable connections could not be made with the feed line, there is installed on the crane a high-capacity storage battery, consisting of 230 cells. It has a capacity of 75 amperes for 8 hours with a maximum discharge rate of 350 amperes for 2 hours.

On a formal test, conducted by the railroad officials, the crane propelled itself at the rate of 34 miles per hour while hauling an 80-ton rolling load. On solid foundation with outriggers, the cranes showed a capacity of 100 tons with a 24-foot 2-inch radius straight ahead, or 6 feet 6 inches to either side of the center. The same capacity was shown with a 22-foot radius operating at 12 feet either side of the center, and with a 13-foot 8-inch radius swinging 180 degrees. Without outriggers the capacity was 50 tons and 25 tons with a 13-foot 8-inch radius swinging 180 degrees. The crane was designed and built by the Industrial Works from specifications prepared by the New York Central Railroad.

One of the cranes with lifting capacity of 100 tons.

The Iceberg Patrol

EVER since the "Titanic" disaster travelers have looked with new respect upon those ancient ice monsters that come down out of the North each year, on their final voyage to the torrid South. Instead of eagerly hoping that an iceberg will be sighted, their presence is looked upon with apprehension. During the iceberg season the North Atlantic is patrolled by United States revenue cutters in the endeavor to locate icebergs. The accompanying photograph shows two huge icebergs and the United States revenue cutter "Seneca," which has just discovered them. The find was made on Easter Sunday. The icebergs were moving southward rapidly into the path of ocean steamers. A warning was immediately sent out by wireless telegraphy to all ocean steamers in the vicinity. The larger one of the icebergs rises to a height of over 125 feet above the water, making the "Seneca" appear like a mere pygmy in comparison. The Government is using every precaution to avert another "Titanic" disaster.



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U. S. revenue cutter "Seneca" and two giant icebergs she has discovered.

Fire Protection on Ocean Liners

By Dr. Alfred Gradenwitz

THE increasing development of ocean navigation has resulted in attempts, on the part of engineers, not only to improve the technical appointments of steamships and to augment the comfort of passengers, but to provide as efficient a protection as possible against any risk of accident. At the recent London Conference, representatives of all the leading nations agreed upon the most appropriate measures to be taken in this connection. On account, however, of the unprecedented dimensions of the "Imperator" and "Vaterland," the latest additions to their fleet of ocean liners, the Hamburg-American Line, in the case of these mammoth vessels, decided to go far beyond the rules laid down at this Conference, adopting not only an improved and admirably comprehensive system of water-tight bulkheads, but a novel type of fire-protection apparatus.

It will be readily understood that a floating palace, accommodating a population of over 5,000, should require far more efficacious measures of precaution than the average liner of relatively modest dimensions, the more so, as any accident there may assume the proportions of a real catastrophe. This is why the two vessels in question have been equipped not only in accordance with the best practice in connection with the fireproofing of buildings, but with many new and unique arrangements.

All iron walls of the passenger decks have been lined on both sides with a fireproof cement coating, cast on wire gauze or molded in slabs. Comprehensive tests made in a special building at the Central Headquarters of the Kiel Fire Brigade, have brought out the excellent qualities of walls and doors such as these. Any bulkhead openings traversed by the passenger corridors on the various decks have

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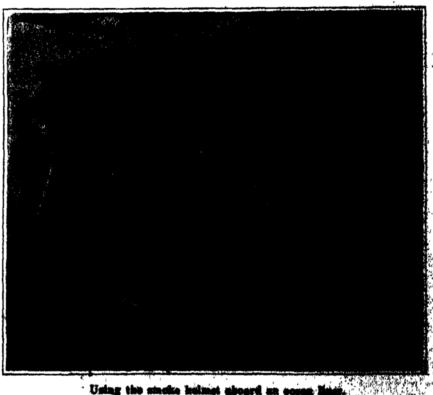
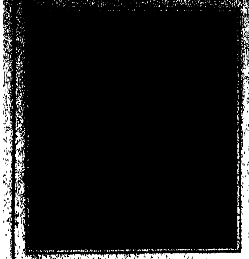


Using the smoke helmet aboard an ocean liner.

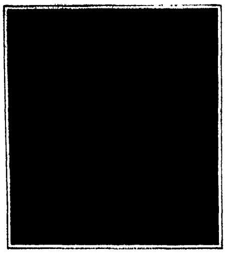


A two-inch gap separated the sweet-pea from the stick.

Have Plants an Unknown Sense?

Some Curious Instances Which Seem to Indicate That the Tendrils and Roots of Plants Have a Mysterious Power of Feeling Objects at a Distance

By S. Leonard Bastin



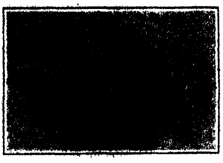
The plant leaned over and secured a hold with its tendril.

IN his pursuit of knowledge the man of science is continually coming across matters which it is difficult, if not impossible, to explain. One of the most sensational facts that have recently come to light is the discovery that plants appear to possess a special sense. It is too early to hint at an explanation of the happenings which force us to this conclusion, but we now know that plants are able to feel objects at a distance. That is to say, they act as if they were aware of the presence of a certain thing, even though they may not be in contact at all. It may be of interest to give a few of the most startling cases which have come under notice.

Everybody knows that the sundew catches flies. The leaves of this plant are, of course, covered with tentacles which, being very sensitive, close in round the captive. But the foliage of the sundew has another remarkable characteristic. If a fly is fixed about half an inch from any of the leaves a most astonishing thing happens. After a short interval it is seen that the sundew leaf has moved perceptibly toward its victim. Soon the cruel tentacles have actually reached the unhappy fly and are seen to be slowly moving round their prey. There is now no chance of escape, and with every moment the fate of the insect becomes more certain. A few feeble wriggles and the fly is dead. When one comes to think of it, it is very strange that a plant should be able to go in pursuit of its prey in the manner indicated. Some plants are very unscrupulous; unable to secure a living on their own account, they prey upon the more hard-working of their fellows. Such is the dodder, a most virulent parasite, which, apart from the first few weeks of its existence, has no roots or leaves and exists as a blood sucker on other plants. The seed of the dodder germinates in the soil, and from this arises a curious thread-like growth. Now it is of vital importance that the young dodder should be able to seize hold of some suitable host, such as a clover plant, for instance. It is strange to watch the manner in which this thread-like growth works in and out through the grass stalks seeking for a victim. When it comes within a certain distance of a clover plant the dodder grows forward at a very rapid pace until a hold is secured. Even the sturdiest plant must go down before the attacks of the cruel parasite. The thread-like shoot is, within a few weeks, multiplied by the thousand, and from every point are produced suckers which draw away the life-giving sap.

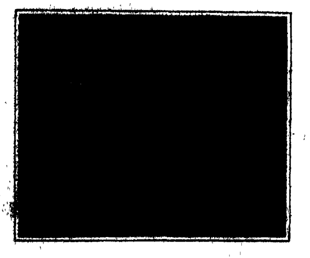
In much the same way the tendrils of climbing plants show quite clearly that they can feel things at a distance. A sweet pea plant which was used in an experiment proved to be exceptionally clever in this respect. A stick was placed near the plant at a distance of two inches, and during the few hours which followed a very strange thing happened. The tendril, which at first was held between the leaflets, where it had been developed, dropped down to a horizontal position. This was, of course, merely a matter of growth, but it was almost at once followed by a very decided movement of the tendril toward the stick. Finally, the whole of the upper shoot of the plant leaned over, meanwhile the tip of the tendril was busy making sure of its hold. One could not very well get away from the idea that the tendril knew, if the word is permissible, that a support was within reach.

Darwin once said that in their clever ways the root tips of plants seemed to evidence as much intelligence as was to be seen in the lower animals. The following instances show that the great scientist was stating the case very mildly.



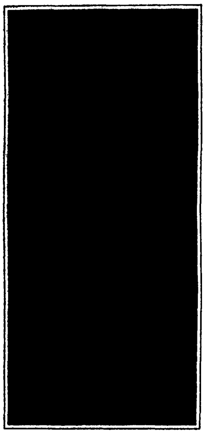
Fly set up before a sundew leaf.

Reaching the fly with its tentacles.



The fern sent down a root on the outside of the pot down to the water in the saucer.

How the hazel roots went down through the willow.



The trailing cactus sent down its roots through a hole in the roof.

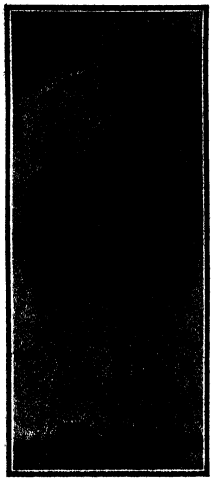
Sometimes plants find themselves in very awkward situations. Such was the fate of a hazel bush, the seed of which had been placed in the upper part of an old willow tree. Now there was a certain amount of soil, formed of decayed leaves, where the seed of the hazel tree started, and for a time this was sufficient for the needs of the bush. But as the plant increased in size the need for more root room became imperative. Yet the hazel tree was a full 12 feet above the ground. Now a strange thing happened, for the hazel bush started to send out roots to the soil beneath. These traveled downward through the hollow trunk of the willow, and finally reached the ground. When this occurred the hazel bush at the top of the tree started to flourish with renewed vigor, and at the moment of writing threatens to become more prosperous than its host. Another strange case of a plant growing down to soil many feet beneath comes from South Africa. This was a species of the trailing cactus which was rambling over the roof of a shed. The roof was formed of galvanised iron, and at one point rust had eaten its way right through. As soon as the stems of the cactus reached this point it at once started to send down an immense quantity of roots through the hole to the ground beneath, a distance of 9 feet. We may take it that the plant was not satisfied with its existing accommodation, and the soil in the shed (which happened to be nice soft mold) offered a tempting medium for fresh root activity. But how on earth could the plant know that it would reach the ground at the end of the journey through the air?

A few years ago some plants of the tropical creeper known as *monstera* were established in a greenhouse. These plants are very fond of rambling about the roofs of the structure in which they are growing, and will often send down roots to the ground. In this particular case the plants made no attempt to develop their aerial roots until they were over a large water tank. Then the roots were produced in abundance, and these traveled down through the atmosphere and finally reached their goal many feet beneath. In another case a little fern sought out some water with an intelligence that seems to be almost uncanny. The plant was growing in a pot, which was kept standing in a saucer; the latter was always well filled with water. Now one may suppose that the fern did not have a sufficient supply of water to meet its needs in the ordinary way, and it determined to get into touch with that in which the pot was standing. Accordingly, the plant sent down a special root, on the *outside* of the pot to the water in the saucer.

In conclusion it is interesting to call to mind a very striking case of root intelligence which was observed by that celebrated botanist, Dr. Carpenter. The instance has never been explained, and it may perhaps be a good plan to give the original description, which was published in 1860. It is as follows: "In a little hollow on the top of the shell of an old oak (the outer layers of which, however, and the branches are still vegetating) the seed of a wild service tree was accidentally sown. It grew there for some time, supported, as it would appear, in the mold formed by the decay of the trunk on which it had sprouted; but this being insufficient, it has sent down a large bundle of roots to the ground, within the shell of the oak. These roots have now increased so much in size, that as they do not sub-divide until they nearly reach the ground, they look like so many small trunks. In the soil, however, toward which they directed themselves, there was a large stone, about a foot square, and, had their direction remained unchanged they would have grown down upon this. But about half a yard above the ground they divide, part going to one side, and part to the other; and one of them branches into a fork, of which one leg accompanies one bundle, and one the other; so that on reaching the ground, they inclose the stone between them, and penetrate on the two sides of it."

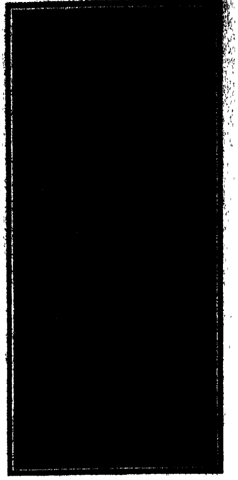
Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks



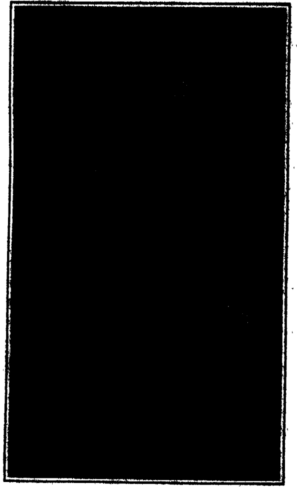
How the "strain" insulators are used.

Insulators buried in snow at the Great Falls power plant, Butte, Montana.



Example of "suspension" insulation.

Subjecting a chain of suspension insulators to a break-down test.

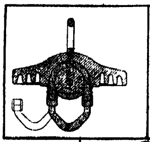


Flow of sparks around the skirts of two insulators; the top disk is punctured.

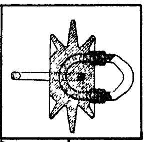
Evolution of the High-tension Insulator

LESS than a quarter of a century ago the first alternating current power transmission line was erected in the United States. The current was transmitted at 3,000 volts, which was considered very high pressure in those days. With that beginning the development of high-tension transmission lines progressed steadily, until by the end of the century, 60,000 volts had been reached. Then, for a time, there was a halt. A serious obstacle was encountered. The development of generating and transforming machinery had outgrown the development of insulation and the former had to wait for the latter to catch up When a new system of insulation was discovered, high tension took up the march again and there was steady progress, until, now, we have transmission lines of 150,000 volts and consider 250,000 volts not an impossibility, but a probability in the course of the next few years

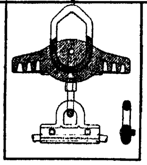
The making of an insulator may seem a very simple thing, involving merely the quantity of insulating material placed between the conductor and the support That was the first idea, but it was soon found that insulators exposed to the weather accumulated impurities, dust and the like, so that when they became wet, they offered a path—more or less imperfect, but nevertheless a path—for leakage of electricity. Then more attention was paid to the shape of the insulator. It was formed with a number of petticoats so as to increase the under surface on which dust and rain would not be liable to collect. With increase of voltage the insulators became larger and larger and the petticoats more numerous until finally they became so cumbersome as to present serious mechanical difficulties in their construction and in the maintenance of the poles upon which they were mounted.



Section of suspension insulator.



Section of strain insulator.



Suspension insulator and line clamp.

The use of higher voltages also developed other weaknesses. Glass was found too brittle and liable to break with variation of temperature. Furthermore, it was easily wetted, so that in rainy weather a film of water would form upon it. Porcelain was substituted for glass and found better in many particulars, but its chief insulating quality lies in the surface glaze. When this is cracked—and it is liable to be cracked by action of the weather—moisture entering the cracks will expand when frozen and rupture the insulator, resulting in a short circuit. Unfortunately when a high-tension line is short circuited, surging is set up which is liable to rupture other insulators along the line. The effect is cumulative, so that serious damage may result from one defective insulator. A search was made for better insulating material, and a number of compounds have been discovered which show greater mechanical strength, which are unaffected by temperature changes and which, being of an oily nature, are not readily wetted with water; that is, the water collects in drops rather than in a film over their surface.

But the problem was more than one of material only. It was a mechanical problem. The pin type of insulator had been outgrown. The next development was to suspend the insulator from the cross arm, instead of supporting it on a pin. Because a flexible support can be made much lighter than a rigid one, this reduced the weight on the cross arm at once. The conducting wire could be supported at a greater distance from the cross arm than was possible before. Furthermore, a chain of insulators could be used in place of a single, large, rigid insulator. This is the type of insulation now in common use on high-tension lines, the only objection being that the line is apt to sway in the wind and might come in contact with its support. This may be prevented by proper spacing and the use of lateral guy lines also made up of chains of insulators known as "strain" insulators. Still another method is to "dead end" the conductor at each pole by means of "strain" insulators, using short loops to carry the current past the cross arm. Both the "suspension" and the "strain" types of insulators consist of disks formed with petticoats or flanges and furnished with hooks at each side, to permit of connecting any number together in a series long enough to provide the desired insulation. The series is often "graded" from a large insulator at the conductor to a small one at the support, thus reducing weight and at the same time increasing the insulating qualities of the series.

The accompanying detail drawings illustrate the degree of perfection to which the present-day insulators have been developed. The constructions are the invention of Mr. Louis Steinberger, one of the pioneers in

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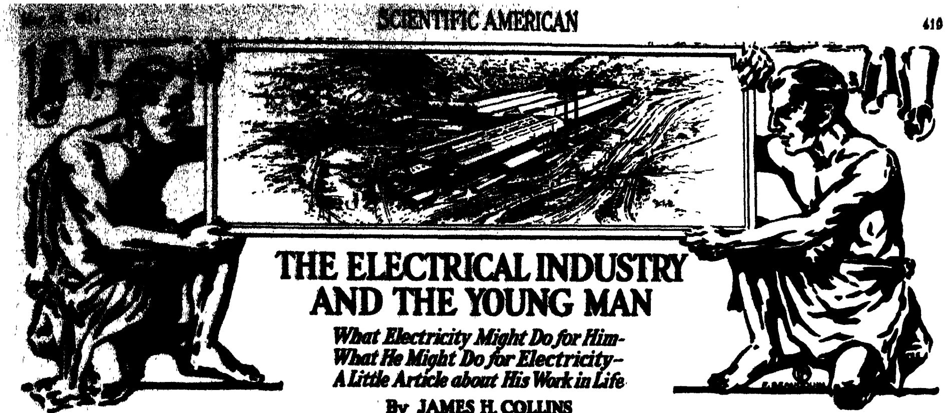

THE ELECTRICAL INDUSTRY AND THE YOUNG MAN

What Electricity Might Do for Him—What He Might Do for Electricity—A Little Article about His Work in Life

By JAMES H. COLLINS

One day, not long ago, a party of officials from Germany visited the main plant of the Westinghouse Electric & Manufacturing Company, at East Pittsburgh.

They walked down an aisle that seemed a mile long, past countless machines where the operators, a number of whom were girls, were winding insulated wire. They were solid serious Germans—real well-fattened husbands of the German *Hausfrau's* ideal. It was a long walk. The most serious member of the party plodded along without comment until the end of the aisle was reached. Then he turned to the guide and said:

"This is a big building."

They were taken around a corner and conducted back through another aisle of the same length, full of men and girls and machinery, and again the serious visitor said nothing until the other end was reached. Then he declared:

"This is the biggest building I ever saw!"

Still the tour continued. They turned another corner, and walked down a third aisle, and now the serious German was getting winded. When the end was reached, he mopped his brow and exclaimed, in astonished conviction:

"Ach! This must be the biggest building in the world!"

Now, suppose a young fellow with his career all before him—say, a liberal arts sophomore, or high school senior—went through the same plant.

He, too, would be impressed chiefly by the size of the place, and very properly. For it is an immense works full of technical apparatus and processes. It is said to be the largest machine shop in the world. Nor is this all of Westinghouse, because the company has plants in other cities of the United States, and in Europe.

A young student would get the general impression that, if he were employed by Westinghouse, he would be connected with a very large concern indeed, with its thousands of workers, and millions of feet of floor space, and plants and output distributed all over the globe—surely a job to be proud of.

Still he might not see the path of opportunity open to him in the electrical industry.

The electrical business has been called the most forward-looking of our great industries. Every day more things happen in electricity than in any other line. More new devices are developed, more progress is made, and electrical service and products touch humanity more intimately.

The path is there, but it needs to be pointed out.

There was a time, certainly, when primitive man's whole idea of the application of power to work lay in carrying his few possessions around with him. And here begins the path of electrical opportunity. He lugged things around until it occurred to him to make pack animals carry them, and that led to the development of the drag or sled.

It was a great day when he cut his sled runners out of the trunk of the tree instead of from a limb. They turned round then instead of sliding, and much friction was eliminated.

For then the wheel was evolved, and civilization ever since has been pretty largely a matter of wheels—wheels and ways to turn them.

At first it was human muscle at the potter's wheel, and wind or water at the mill wheel, and horses on the chariot. These were the sources of power for centuries, and as long as they were retained the wheel that was turned never got very far from the power that turned it.

By and by, however, steam was utilized to turn wheels, and then came power transmission. Wheels could be hitched to wheels by shafts, gears, belts. One big wheel turned by a steam engine ran hundreds of lesser wheels, animating a whole factory.

Yet even with steam and the mechanical transmission of power, wheels were never made to turn each other at any considerable distance from the prime mover. It is true that cableways with wire ropes running on pulleys supported on piers were successful for distances of several miles—the cable street car was familiar only yesterday. It is true, also, that hydraulic and pneumatic transmission of power were in a very promising state of development yesterday, and are even utilized to-day under certain conditions.

But, suddenly, something happened to all the mechanical methods of power transmission.

Electricity came in between the big wheel at the prime mover and the little wheels at the other end, and the face of material civilization was changed almost in a day.

The superiority and wonder of electricity lie in its ability to turn wheels in ways never dreamed of with any mechanical system. It is the ideal and universal form of power transmission.

A copper wire is stretched from the place where power is generated to where it is wanted for work. Old limitations of [illegible] are [illegible] disregarded. There [illegible]. The wire can go up heights, down depths, around any maze of corners, and to distances that are restricted only by questions of economical operation. At one end of the wire the dynamo moves. And at the other end these mysterious waves that we call "electricity" turn a wheel in a motor—the power is available.

Besides turning wheels, electricity can be taken off the wire as light or heat, so it has a three-fold application.

Electricity is the most *flexible* form in which power can be had.

It may be generated in enormous quantities at the central station, by steam or water, and delivered in the tiniest driblets to anybody who wishes to purchase.

Without electricity, there could be no power in the average home.

But with electric current from a central station miles away, any home may have cheap power in any quantity. A penny's worth may be bought to sweep a room or chop the hash. Or it may be utilized as heat to iron the towels, or as light wherever needed. Electricity is available instantly, at any hour of the day or night, calls for no skilled attendant, is under perfect control, clean, safe, cheap, and delivers just enough power for the task.

This flexibility, economy, ease of control and cleanliness is just as great in the largest applications of industrial power—machines directly driven by electric motor make the modern factory cleaner, quieter, lighter, more efficient and better in every way.

⁂

The ambitious young man, leaving school and becoming part of the Westinghouse organization, would start at the very beginning of the path of electrical opportunity. But with energy and ambition he could soon travel far enough to see that it branched off in two directions.

First, there is the technical end of the business, engaged in developing and improving electrical apparatus.

Second, the distributing end, which is busy applying electricity to a wider and wider range of human service.

⁂

As the visitor walks through the Westinghouse works, he sees a bewildering variety of operations. Metal is being molded, forged, welded, bored, turned, pressed, spun, ground, polished. Wire is being wound in an infinity of ways, and sheets and plates of conducting metal built up to complicated patterns. There is a range from the gigantic to the microscopic, for in one plant big cranes handle parts for enormous turbo-generators, and in another the bearings of wattmeters are being fitted with tiny jewels. There is constant talk of armatures, commutators, condensers, resistances, alternators, rectifiers, single-phase, polyphase—a perfect Babel of technical terms.

In the end, however, it all comes down to about the same thing.

No matter what the contraption is called, or how large it may be, or how delicate, or complicated, it is likely to be just a special device for conducting current along a particular path so that it is made to accomplish a particular form of work.

Electrical development has been largely the development of ingenious paths for current. This development of new paths has been going on since Franklin provided his kite-string path for the lightning. Each year brings new subtilties, and every important new electrical installation calls for special refinements. So, the young man who finds the technical side of Westinghouse activities to his liking will have plenty of room to turn around in, and unlimited scope for the future.

Take the electric light, for instance. It began with the arc lamp. Close upon the arc lamp followed the incandescent bulb, in which current had to pass through a charcoal filament in a vacuum. Then followed improvements on the charcoal filament. Then the carbon was metallized—better yet. Then *metal* filaments of tungsten and tantalum were devised—and improvement after improvement on the metal filament. Better, and still better.

To-day the electrical industry is agog over the latest invention in incandescents—the metal filament in a bulb filled with nitrogen vapor, which gives out a glorious sunburst of several thousand candle-power, with a quality closely approximating daylight.

Another example is found in alternating current—peculiarly a Westinghouse development.

The first commercial electricity was direct current. That is, it flowed continuously from the generator in one direction along the wires. Direct current was extremely limited in scope, because it could be transmitted only a few miles. Its voltage, or pressure, was low—only 100 to 200 volts. So it had to be sent over heavy copper cables—in effect, a lazy flow in large volume, and not equal to much work after it had traveled any considerable distance. Even had direct current been effective on long transmission, the cost of the cables was a barrier against its practical development.

Alternating current, on the contrary, is divided into infinitesimal halves as it issues from the generator, each alternate half flowing in an opposite direction, with anywhere from a few to many thousands of alternations per second.

It can be sent at high voltage through small wires to great distances—at present practical transmission has reached a radius of 200 miles. Its pressure can be "boosted" up at any point along the line to maintain or accelerate the flow, and when the current arrives at the point where it is to be transformed into work its pressure can be "stepped down" to any required voltage.

The Westinghouse organization took up alternating current in its babyhood, when it was largely a scientific curiosity from Europe, neglected because nobody believed it could be made practical, and even regarded as dangerous.

First, a generator producing alternating current up to 1,000 volts, and capable of transmitting electricity to a distance of a mile or more, was built by the Westinghouse organization.

But how to use it for light and power was another matter, because such high pressure instantly destroyed any form of electric lamp, was unsafe inside a building, and would not turn the direct-current motors then in use.

The "transformer" of Gaulard and Gibbs, at that time a laboratory freak from Europe, was taken up by the Westinghouse organization, and perfected, so that current at 1,000 volts could be transmitted over considerable distances, and then reduced to normal lighting pressure. The first great installation of alternating current for lighting was made at the Chicago World's Fair in 1893, and was distinctly a Westinghouse triumph. To day, transformers are made in all sizes, for all voltages and types of service, up to 150,000-volt giants for transmission lines.

And with the high-voltage transformer comes the condenser terminal, perfected by Westinghouse to lead high voltage currents safely into the transformer, and capable of handling over 150,000 volts and tested for 375,000 volts.

Motors, too, are paths devised to make electricity perform many sorts of work, from the little fractional horse-power motor that turns a dentist's drill up to the 156-ton Westinghouse electric locomotives used by the Pennsylvania Railroad. And to the making of new types there is no end.

The mercury rectifier is another path for current, and a mighty interesting one. It is a large glass bulb, filled with mercury vapor, and in use looks just like the familiar Cooper Hewitt lamp used for lighting. It gives the same greenish-bluish light—and is, in fact, a modification of that lamp. The mercury rectifier takes an alternating current at two poles, splits the two halves, and sends them out, flowing in the same direction, at a third pole, and thus converts alternating current into the direct current necessary to charge the storage batteries of an electric automobile.

The little electric flatiron now coming into such wide use for housework is a particular path for electric current, its heating element being designed to transform electricity into heat with the highest economy. So are the other heating devices for household use, such as the electric stove, electric radiator, electric toaster, coffee percolator, chafing dish and so forth.

So are the industrial heating devices found in every manufacturing plant—the soldering irons, melting pots, welding devices, vulcanizers, sterilizers, heaters and many other conveniences for operation by electric current. So are the electric meters, the spark coils and vibrators, the controllers and converters, and almost every other form of electrical apparatus—paths—all paths.

⁂

The other great division of the Westinghouse organization is that which distributes this infinitely varied product to the world.

Not long ago, an engineer, visiting East Pittsburgh, found that Westinghouse electric generators aggregating half a million horse-power were under construction, and he further learned that the average monthly output of the Westinghouse Electric Company approximates one-half million horse-power.

In 1890, census returns showed that the electrical energy used in our factories amounted to less than sixteen thousand horse-power. To-day, the aggregate is fully five million horse-power.

In 1890, our street railways used a few hundred thousand horse-power of electrical energy. To-day, their total exceeds five million horse-power.

In 1890, the central station industry was a struggling infant. To-day, it is employing capital aggregating two and a half billion dollars, and one of the best banking authorities in the United States says it can normally develop at the rate of four hundred million dollars yearly for the next five years.

Figures of this sort could be strung out to any extent. A few big items are given here to indicate the scope of the market for electrical products, and to make clear to the young man who might find the distributing part of the Westinghouse organization most to his liking, what a field lies open to him.

From the days when alternating current was being developed by the Westinghouse organization, this "wholesale" side of the demand has been fascinating to the kind of young man who likes the human and the technical blended in his work.

From one industry after another has come up problem after problem, to be solved by study of the conditions and original designing of apparatus. And the Westinghouse organization has not waited for the problems to come, but has gone out into many industries and dug them up on its own initiative.

Special generating, transmission and motor equipment have been made to solve these problems, both in alternating and direct current apparatus.

Twenty years ago the 1,000-horse-power Westinghouse generators built for the Chicago World's Fair were regarded as giants. But to-day, single generating units of 45,000 horse-power are being built by the Westinghouse Company for central station and electric railway service, and promise to become quite common by reason of their great economy in producing power. It is largely a matter of developing the market for such quantities of power—for a single generator of that capacity would run all the men's clothing factories in the United States.

In steel mills, motors have been adapted to the individual driving of every machine, and made fireproof to withstand the hard service.

In mine and other service, they have been made water-proof.

In the textile industry, they have been modified in many ways to meet peculiar demands in spinning and weaving.

In railway service, they have been built to give high speeds and great tractive power, coupled with maximum strength and minimum weight.

In machine building, printing, shoemaking, construction and many other industries they are provided in every conceivable size and type, for individual or group driving of machinery, making possible the purchase of power at the most reasonable prices, its use with the least loss, the utmost convenience in running at any hour of the day or night, and ease of measuring power consumption of individual machines or departments.

And every day this wholesale demand for electrical apparatus grows, not only in volume, but in breadth and interest.

As an illustration of that, the enormous field in transportation may be touched upon.

The electrification of our railroads is pretty certain to come about during the present generation. Electrification of suburban divisions running out of the largest cities has demonstrated the immense economy of the new power, and this is being followed up by the electrification of mountain divisions where present operating costs are high. Water power is being developed on such a scale as to provide electricity for railroads everywhere. Trolley systems are being linked up into true railroad systems Electric power is proving to be the most economical means for developing new territory, giving service to communities beyond the economic reach of steam roads. Electrification of the steam roads is no longer a technical matter, but one of finance and management. Even in water transportation, the electrical propulsion of ships promises to be the most economical means of utilizing the high speeds and low costs of steam turbines.

On top of this there is an enormous "retail" demand—and the still more enormous untouched retail field, which must be turned into consumers for the vast amount of current that will be produced by the great electric power plants now just coming into operation and still building.

To market such volumes of power, electricity must be extended not only to factories, but to homes. To put electricity into the homes calls for the highest type of educational selling. Apparatus is being perfected daily by the manufacturing end of the electrical business. The electric flatiron, washing machine, heating and cooling devices and so forth are ready for the public. Electricity is beyond question the ultimate solution of the servant problem.

The carbon filament lamp was standard yesterday. Originally, it consumed so much current that it was restricted to well-to-do homes. Then its efficiency was increased, and it came in reach of a wider public. To-day, the new nitrogen lamp is cutting current consumption down to as little as one-twelfth the consumption of the old carbon filament lamp, and the use of electric light has been made universal, in theory—with the practice delayed only a little. Small household motors have been perfected in the same way. Likewise household heating devices—and electric cooking for many homes is a possibility of the immediate future.

In 1880, the country's whole output of electrical apparatus was worth only two and a half million dollars. In 1890, it had grown to only twenty millions. To-day, a million dollars' worth of electrical apparatus is produced every day in the year.

Each development of apparatus, each lowering of costs, extends the field for putting electricity into more homes, in theory.

But, as a practical proposition, people must be taught and persuaded. They must be shown how to use those electrical conveniences which are already within their means, and how a larger capital investment in apparatus will secure lower cost of living and greater comfort.

So the popularization of electricity calls for the highest kind of selling effort. Along with the potential home demand, which increases far more rapidly than selling effort can keep pace with it, there is the small industrial demand from manufacturers, merchants and business concerns whose requirements of a few motors and electrical tools do not bring them into the wholesale class.

To cultivate this vast retail field is not the work of the central station alone, though the latter, it is true, sells the current. It calls for the close co-operation of the electrical manufacturer, and is a field in which the Westinghouse organization has always been active, making studies, developing sales methods and working with the distributors and users of electricity.

If all the demand from homes and small industrial concerns were suddenly to cease, there would still be a lifetime of work for hundreds of young men in taking care of the new retail demand just rising—that for electricity on the farm. This is coming, surely and quickly, with the electrification of the railroads, the development of water-powers and the extension of central station transmission systems into country districts.

Now, what can the electrical industry do for the young man?

And what can he do for the electrical industry?

It is usually assumed that a business so largely technical needs none but engineers, electricians and men of technical training.

But that is a very narrow view—quite mistaken.

To-day, industry is being humanized, both in its relations with the public and with its own workers. New standards are being set and new ideals worked out—ideals that would have been scouted as theoretical and altruistic five years ago.

The electrical industry always needs the young man of general education, broad sympathies, clean life, energy, ambition, open-mindedness, the faculty for getting on with other men, the ability to look ahead and visualize to-morrow, the man who can teach and inspire others while he learns and grows himself.

Electricity's need for young men is constant, in every department of the industry, both production and distribution.

Knowledge is an advantage, whether technical or general, and at the same time is only something to start from.

The young man himself is chiefly a potentiality, to be introduced into the industry somewhere, given specific tasks, tried, gauged, placed, developed and advanced according to his individual ability. If he has the energy and the ambition, the path of electrical opportunity is open to him. If he is not well placed at one kind of work, he can be tried at others—the field is unlimited in its scope and diversity. If he can grow, his development will mean the development of the industry in some detail or direction, and no matter how fast he may be capable of advancing, there is certain to be plenty of room ahead of him, always.

Electricity is essentially a young man's business.

It is alive all over, both in ideas and in its physical organization.

It is a business of to-day and to-morrow—not yesterday.

Business in general is very apt to be grounded on personal policy. The opinions and methods and energy of a few leaders prevail. Time and change bring habit and tradition. Conservatism creeps in, narrowing the outlook and limiting the possibilities.

But the electrical industry is grounded on scientific truth. It grows on a solid basis of experiment and research. Being built on actualities, and always subject to correction of natural laws, there is no room for the entrance of personal rule, prejudices, habits, traditions, the limitations of mere opinion.

As a young man's business it is typified in the Westinghouse organization. From the first, Westinghouse has been an organization of young men, alive, looking into to-morrow, trained down to the minute. It is a young man's organization to-day, and always will be in spirit and methods, no matter what its age may happen to be in years.—*Advertisement.*

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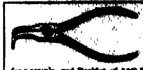

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Analyzing the Human Singing Voice

(Concluded from page [illegible])

partial tone (fundamental and overtones) separately and all of them collectively," observes Dr. Muckey. "The first thing we notice is that the waves vary in length, the wave in the lowest line of the voice-tone photograph being longer than that in any other line, and the one in the second line being just half of that in the first. We find that the tone represented by the second line is the octave of that represented in the first line.

"The waves gradually diminish in length as we go up in the series and the pitch of the tone rises. This proves that the length of the wave determines the pitch of the tone. Then we observe that the waves vary in height, the waves in the first line being highest. They gradually diminish in height as we go up in the series.

"Our experiments have demonstrated that the fundamental tone, or the one with the highest wave, has the greatest carrying-power, and that the other waves, representing the overtones, diminish in direct proportion to the lessening of the height. Thus we have intensity and carrying-power equal to the height of the wave.

"Our experiments have shown, also, that any change in the number and relative intensities of the partial tones makes a corresponding change in the quality of the tone, and, so, we have quality dependent absolutely upon the number and relative intensities of the partial tones. If we take away one partial tone it changes the quality of the tone as a whole, and if we take away several it makes a very decided change in the quality. Similarly, if we change the intensity of any one or more of the partial tones, it makes a corresponding change in the quality."

He adds, in summing up the results of his two decades of labor with Prof. Hallock:

"Resonance has been the keynote of our work. It has been at once our tool, and the object wherefor we have striven. For our purpose resonance may be defined as the reinforcement of a tone by a quantity of more or less confined air, the inherent rate of vibration of which is identical with that of the tone reinforced. Such a quantity of air receiving successive impulses from the vibrating source, or object, comes into vibration itself, thus giving to the surrounding air a much greater amplitude of vibration and consequently greater intensity and carrying-power to the tone."

Several improvements in the manometric flame tone analyser have been devised by Prof. Hallock. A simpler construction and the elimination of much of the rubber tubing of the Koenig-Helmholz apparatus have brought it to a stage where it not only registers more satisfactorily the tone-production of the voice, but begins to fulfill the long-felt want of a recorder of the tonal quality of musical instruments of every character, and especially of those of the string family—the pianoforte, the violin, the 'cello, etc.

Fire Protection for Ocean Liners

(Concluded from page 416.)

been closed, in accordance with the best actual practice, by fireproof glass doors designed to withstand a temperature of upward of 1,000 degrees.

In addition to the iron bulkheads thus lined with fireproof coatings, a new type of fire-resisting transverse walls has been fitted at regular intervals, the design of which is another outcome of the above tests. These walls are likewise provided with fireproof doors. Special care has been bestowed on the insulation of the staircases. The main staircase, over which passes most of the passenger traffic, has an entirely fireproof lining, so that each vestibule constitutes, as it were, a smoke-proof lock. Fireproof elegant glass doors insure an easy access to the staircases. This scheme, which complies with the very stringent regulations of the German police authorities for the fireproofing of department stores, warrants, according to any human provision, a narrow localization of any conflagration and a safe escape from [illegible]

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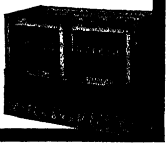

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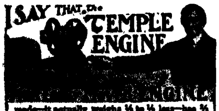

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made—it actually weighs ⅓ to ½ less—has ⅔ less bulk—occupies ⅓ to ½ less space—than any horizontal engine of same power capacity. Look at the "Temple" Design and see for yourself that it is true. Made 2 H. P. to 50 H. P., using gasoline, kerosene, alcohol and distillate.

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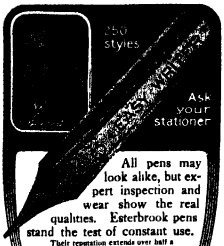

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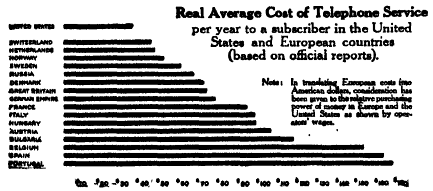
Dr. R. Luther, in the Dresdner Anzeiger

"In the year 1913, 36 years after the discovery of the electro-magnetic telephone, in the age of the beginning of wireless telegraphy, one of the largest cities of Germany, Dresden, with half a million inhabitants, is without adequate telephone facilities."



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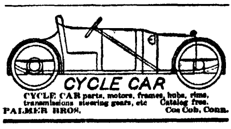

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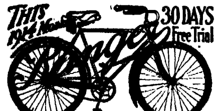

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In the rear part of the promenade deck, there is a guard-house and central station for all fire alarms. Five professional superintendents, trained at the Kiel Fire Brigade, under the guidance of a responsible chief officer, have been intrusted with a well-organized watching and patrolling service and with the upkeep of all fire alarms and signaling apparatus on board. There are in all 450 fire alarms converging toward an annunciator board in the guard room. These electrical fire alarms, which are arranged to work automatically at a given temperature, are installed not only in the cabins and saloons, but, with wise foresight, in the less frequently used holds, refrigerating chambers, post offices and storage rooms.

As regards the rooms destined for the crew, another step was taken to insure even greater safety against fire, by the installation of automatic sprinklers. There are 800 sprinklers of this kind aboard the "Imperator." As soon as some of them are actuated automatically, the pressure in the pipes decreases, thus operating an electrical alarm at the central station. The extinguisher pipes are in their turn connected directly with the general sea-water conduits, thus providing always the water required to produce the necessary head and dispensing with any special pump in the event of an outbreak.

Reference should also be made to the Rich apparatus, arranged to work with carbonic acid instead of with steam as heretofore, and to the new Draeger apparatus, both of which, it will be recalled, won the SCIENTIFIC AMERICAN Safety Medal. These, in conjunction with the customary König smoke helmets, are bound to prove most helpful in the case of smoke production.

Evolution of the High-tension Insulator

(*Concluded from page 418.*)

the development of high-tension insulation, he being the first to make successfully, and on a commercial basis, high-potential insulators from a material other than glass or porcelain. It will be observed that the suspension members are imbedded in the insulator and interlaced, so that should the insulating material be shattered, the line would still be supported by a chain made up of the suspension members. Owing to the swivel form of the terminal, two or more units may be connected or disconnected in the fraction of a minute, no special tool being required to operate the connecting nut, as a plain wrench, a nail or even a piece of wire may be employed. The clamp, which is shown suspended from one of the insulators, is formed with flared ends to prevent crystallization and possible breaking of the conductor as it is swung back and forth by the wind. The disk or suspended type of insulator has become so standardized that it is used on all lines operating above 50,000 volts, and even on lines of 44,000 volts in some instances. The 10-inch disk "strain" and "suspension" insulators here illustrated have been tested to show a puncture value in oil of 150,000 volts, and of 100,000 volts when tested to dry arc value. The rain arc value is 55,000 volts, line voltage 25,000 volts and mechanical value 20,000 pounds, while the weight is not 11 pounds.

A New German Life-saving Costume was exhibited at the International Conference on the Safety of Life at Sea, in London, by its inventor, Paul Raschke, a tailor of Breslau. It is made of a composition of aluminium and rubber, with a padded belt around the body under the arms. The outfit includes a pouch intended to contain supplies of food and drink. The inventor demonstrated his apparatus in the Thames. He adjusted the suit in less than three minutes, jumped in the river, where the costume kept him afloat, and propelled himself in any desired direction with a pair of paddles. Taking a cigar from his pouch, he lighted it and smoked most of the time he remained in the water, about 45 minutes. He claimed that the suit kept him comfortably warm in the cold water.

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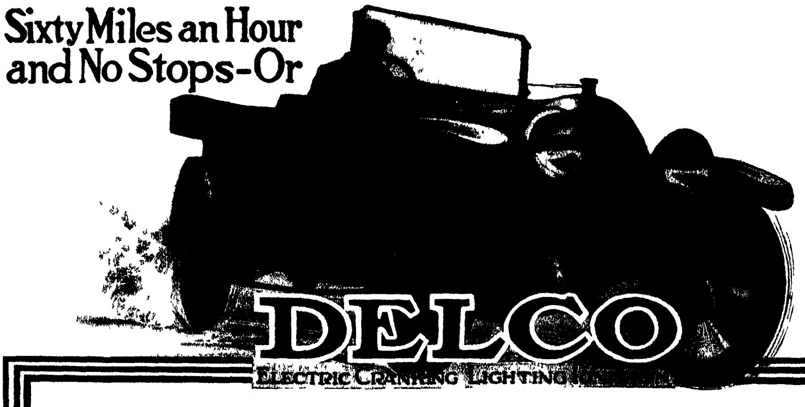

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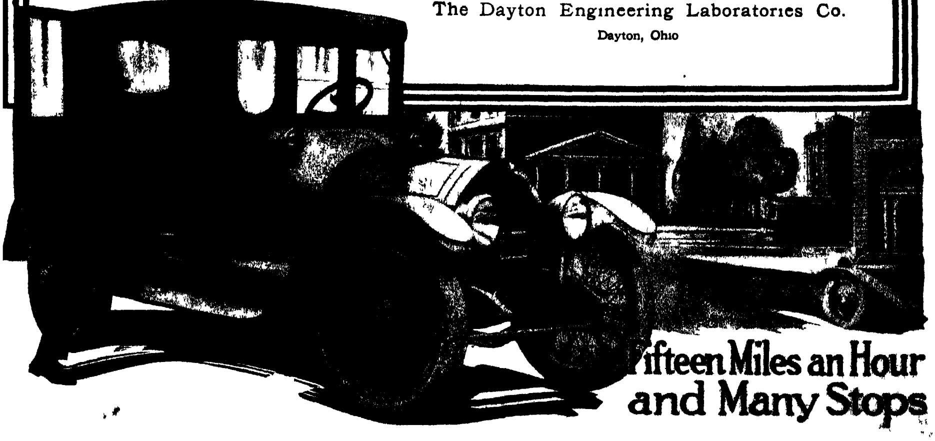

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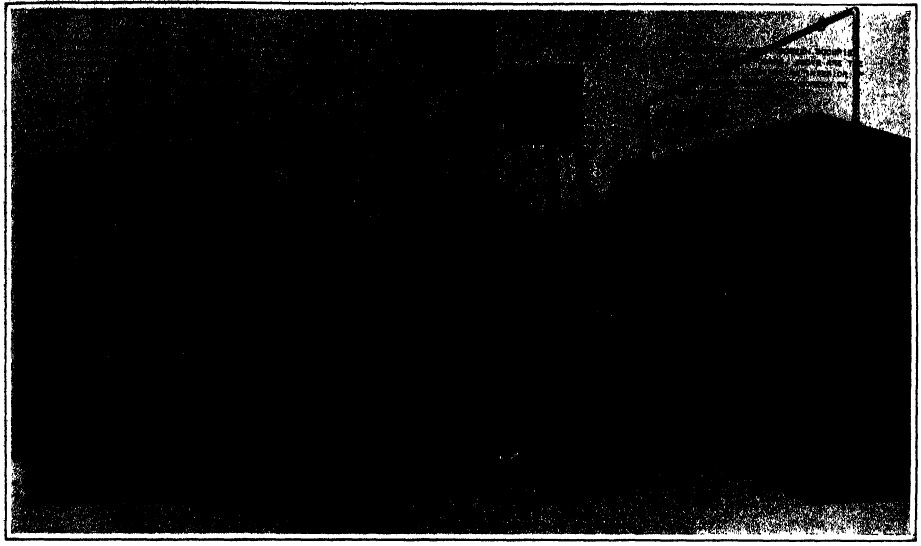

Improved kinematograph target apparatus used in England to train sharpshooters.

Training Marksmen by the Kinematograph

FOR some years past considerable ingenuity has been expended in the effort to turn the kinematograph to distinct value in the training of marksmen. Unfortunately the problem was attended with many peculiar difficulties, that of accurately and instantaneously recording a hit upon the moving subject being the most elusive. In order to render the application of any pronounced value, both to the recruit and to the officer in charge, it is imperative that the hit shall be shown upon the screen.

Recently such a system has been perfected in England, and has met with warm approval from military experts. Briefly, the system comprises the projection of pictures upon a moving screen, which is perforated by the bullets, the hit being revealed by a light showing through the puncture, and the picture being held stationary for a few moments to enable the full results of the hit to be observed.

While the apparatus is necessarily somewhat intricate, its operation is extremely simple and automatic throughout. The projector follows the usual lines with a few special attachments to adapt it to this application. The screen is of special design, and is formed of traveling rolls of paper, the movement of which is controlled by the lantern mechanism.

The essential feature of the invention is a very sensitive microphone, which is connected to a delicate relay. The microphone itself is set up above the screen out of the firing line. When a shot is fired the report of the discharge is caught by the microphone and brings the relay into operation. This relay controls a magnetic clutch placed upon the motor drive of the projector, and, at the sound of the shot, this clutch is brought into operation, the drive is interrupted, and a powerful instantaneous brake applied to arrest the movement of the projector, with the result that the image of the film at which the marksman fired upon the screen stops in the gate, producing the same steady stationary image as if it were a lantern slide. The blades, or opaque sectors, of the revolving shutter are mounted in a free wheel manner, so that although the projector mechanism [illegible] the blades continue to revolve at normal speed. Consequently, although the picture is stationary upon the screen the light is intermittently cut off as in ordinary kinematography.

While the microphone and relay are essential parts of the invention the screen moving mechanism is in every way as important. The screen itself is carried upon the face of a large iron box, the back wall of which forms an impenetrable obstacle to the bullets. The front space of the front wall of this chamber is filled entirely by the screen. At the bottom is a roller on which the paper is coiled. The free end of the paper is then carried upward to the top of the space, where it is passed over a second roller, and down once more to be wound upon a second bottom roller, mounted above the first one. Consequently, as the paper is fed upward and round the top roller it descends to the third roller to be coiled up, and as the movement of these two lower rollers is identical and synchronous the tension of the paper is maintained. In this way two traveling thicknesses of paper are provided, the foremost moving upward and the one behind moving downward. The movement, however, is not continuous, but intermittent, and is governed by the mechanism acting in conjunction with the microphone and relay.

But in addition to the foregoing two thicknesses of vertically moving paper there is a third sheet. This is coiled at one side upon a vertical roller, passed across the screen space behind the two above-mentioned thicknesses of paper and wound upon a second vertical roller at the opposite side. This sheet is employed to serve as a stiffener to the two thicknesses in front, and is kept very taut. It also reduces the possibility of showing a repeat hit. The sheet is moved by hand at various intervals, according to the extent to which the target is used. In some instances movement of an inch or two in a horizontal direction once an hour is quite adequate. It will thus be seen that the screen in reality comprises three thicknesses of paper superimposed vertically, two of which travel in a vertical direction, while the third moves in a horizontal line.

Behind the screen, within the steel chamber, but out of the firing line, powerful electric arc or incandescent lamps are fitted. Thus the interior of the chamber is brilliantly lighted, but this fact is not apparent from the front because the paper screen forms an opaque wall.

When the shot is fired it penetrates the three thicknesses of paper, and the light placed behind showing through the puncture indicates exactly where the bullet has struck As the picture at this juncture is stationary upon the screen, it is possible to determine at once from the position of the shot-hole relative to the subject of the picture whether the shot was effective or otherwise. For instance, if the picture represents a sharpshooter firing from behind cover, the officer can ascertain immediately whether his man at the firing line hit his opponent, and if such were done before the latter fired.

The duration of the period for which the picture stands stationary is governed from a control board, which is automatic in its action. The relay connected to the microphone is mounted at its base. At the extreme top are coils serving as magnetic blowouts to quench the induction spark of the screen-shifting mechanism, which is a solenoid automatically operated from this point. Immediately below are timing solenoids and a dash pot and plunger. As soon as the projector mechanism is arrested, and the picture is brought to a standstill upon the screen, this plunger commences to move. When it has reached the limit of its travel it re-establishes contacts, which sets the screen mechanism in operation. By varying the travel of this plunger the stationary period of the picture upon the screen may be varied within certain limits, according to circumstances.

The screen mechanism is very simple. On the horizontal roller upon which the paper is coiled to be unwound is a ratchet and pawl movement actuated by a solenoid. When the plunger on the control board reestablishes contact the ratchet of this screen roller is moved, and the outer sheet of paper moves upward for a distance of one eighth of an inch, the return or second sheet moving a corresponding distance downward simultaneously. As the two sheets are displaced in opposite directions the shot-hole in each, through which the back

(*Concluded on page 436.*)

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Energy from the Sun

IN view of the fact that the sun delivers energy to the earth at the rate of 7,000 horse-power per acre, it is not surprising that the problem of devising a motor which shall transmit this energy into useful work has proved an attractive one to the experimentalist, as a study of the files of the SCIENTIFIC AMERICAN during the past few years will show. Thus, in California there was erected a plant in which the heat rays were made to converge upon a steam boiler, that generated sufficient steam to run an 8-horse-power pump—this plant being an elaboration of Ericsson's early experiments upon which he is credited with having spent $150,000. Two more modern and perhaps better-known installations are those erected at Philadelphia, and later at Meadi, Egypt, the plants in these two experiments being designed on the principle of concentrating the sun's rays upon a boiler of large area and very low pressure.

An analysis of the Egyptian plant, made by Mr. A. S. E. Ackermann, B.Sc., in a paper read recently before the Society of Engineers in London, shows that, while these experiments have decided scientific interest, they give but little promise of the commercial success of the sun motor. The temperature of the sun is estimated to be about 6,000 deg. Cent., and, theoretically, about 95 per cent of this should be convertible into work. The energy convertible into mechanical work falls from 95 per cent of 7,000 horse-power per acre to 25 per cent, or say, 1,750 horse-power per acre. Even this amount cannot by any means be realised in practice. In some regions the atmosphere cuts it down by nearly fifty per cent, though the loss is considerably less in arid areas.

Recently Mr. Ackermann made a series of trials at the Meadi plant which extended over three weeks; during which he was able to record as the highest output only 19.1 pump horse-power from a sunshine-absorbing plant covering seven-eighths of an acre. That is to say, he recorded less than 20 pump horse-power, as against the 6,000 horse-power which would have been obtained from a perfect motor, capable of utilizing the sun's radiation direct. In the Philadelphia plant, in a test lasting for five hours, Mr. Ackermann obtained results equivalent to the development of an average of 18.54 horse-power from a sunshine-absorber of 0.41 acre extent. The maximum development in the test was 26.8 horse-power and the lowest 8.6 brake horse-power.

These results show how little promise there is of obtaining mechanical energy from the sunshine on a commercially economical scale. Such plants as these at Philadelphia and in Egypt suffer, in an exaggerated form, from the drawbacks attaching to wind power, namely, the great area occupied, the costly cumbersomeness of the plant, and the great variability in the rate of power production. A windmill 40 feet in diameter has an output of about 8 horse-power, and costs $250 per horse-power; and it can be relied upon to work not more than one third of the total number of hours in the year.

In the Meadi plant the five steam generators consist each of a huge mirror 201 feet long by 14 feet in width, which concentrates the rays on a cast-iron boiler, 3½ inches by 14⅝ inches by 205 feet long. The mirrors are mounted on rollers and follow the sun from east to west The plant gives the best results when working with a steam pressure of 6½ pounds gage. In the Meadi test the engines did not work well, and the steam consumption was very high. But even with low-pressure turbines the output in brake horse-power would amount to an average of only 70 brake horse-power per acre This means that a 1,000-kilowatt plant would call for a gathering ground of nearly 14 acres, and even this would be available at the above rates for not more than about three thousand hours per year under very favorable climatic conditions.

Of course there would be a great increase in the output, if the steam pressure were raised, say, to 200 pounds per square inch; but since a sun motor must be placed in the open air, the increased losses due to convection would greatly offset any gain due to the higher pressure.

Construction of Battleships at Government Yards

THE question of the wisdom of constructing battleships at Government yards once more has been the subject of debate in the House of Representatives, when the arguments in favor of the policy were strongly urged by Representative Fitzgerald of New York. For many years the SCIENTIFIC AMERICAN has advocated the policy of having at least one battleship under construction at one or other of the navy yards; and the arguments which we advanced many years ago when the subject was first under discussion are valid to-day.

The country has at least one yard, that at New York, which is fully equipped for building dreadnoughts of the largest size. In fact, the keel has just been laid of a ship which is to-day the largest under construction for any navy. There have been successively built at this yard, during the past twelve years, the "Connecticut," the "Florida," and the "New York." The work on each ship was absolutely first-class, and in the case of each there was an increase in the rapidity of construction over its predecessors.

The principal arguments in favor of Government construction are, first, that a spirit of healthy rivalry is promoted between the Government and the private shipbuilding yards, and, secondly, that the construction of a battleship serves to keep together a large navy yard working force, which, if there were no such work on hand, would have to be more or less broken up and scattered during the slack season. As to the first condition, it is sufficient to refer to the facts brought out by Mr. Fitzgerald that, when the Government yards were first utilized for the construction of battleships, contractors took from 36 to 40 months in excess of the contract time in which to complete them; whereas to-day vessels authorized for the Navy, because of the keen competition of the Government yards, are completed within the time fixed by contract.

The advantages of maintaining a large working force of skilled mechanics, continually, at such a yard as New York is self-evident. Now that so many of the minor repairs are done aboard ship, there is not sufficient overhaul work at the yards to keep the force up to its full quota. That the private establishments understand full well the economic value of holding together a thoroughly drilled force of workmen is proved by the fact that they will often, in slack times, take work at cost or very little above cost merely for the sake of holding their forces together and keeping their plant in operation.

There is the further and very forcible argument that in the event of hostilities, when the yards have to be suddenly worked to their fullest capacity, the existence of a large body of trained and well co-ordinated forces would be of inestimable value.

Col. Roosevelt's Discoveries in South America

DURING the last two or three years the northern drainage slope of the Amazon basin has been much more fruitful than the southern of geographical discoveries, including the notable achievements of Hamilton Rice, Koch, and Farabee It is therefore a matter of special interest that the Brazilian expedition of the American Museum of Natural History, led by Colonel Roosevelt, has traversed a long stretch of virgin territory among the southern tributaries of the great river, and made important additions to the map in the very heart of the region which most contemporary cartographers mark "Unexplored." Colonel Roosevelt was accompanied by the experienced naturalists George K. Cherrie and Leo E. Miller, of the American Museum, his son Kermit, and [illegible] sion headed by Colonel Rondon, [illegible] well known in connection with [illegible] interior of Brazil.

That the results of this expedition [illegible] tremely valuable is sufficiently attested by [illegible] the explorers collected over 2,180 birds and [illegible] besides a number of reptiles, [illegible] mainly in regions not previously visited by [illegible] The principal geographical achievement of the expedition is claimed to have been the mapping of a river nearly a thousand miles long, the existence of which had previously been only vaguely known or suspected, and which on account of its problematical character, had acquired the name Duvida ("Doubt") The Colonel's description of this stream is as follows:

"The upper part of its course was utterly unknown to anybody except the wild Indians along its banks, while the lower part was known to a few rubber men only. The river takes its rise in the high uplands of the western part of the state of Matto Grosso, just north of the thirteenth parallel of south latitude, and between longitude 59 and 60 west of Greenwich.

"We embarked in latitude 12 degrees 1 minute south and longitude 60 degrees 15 minutes west.

"The river ran with many doublings and twistings, almost due north into the River Madeira, where its entrance was at about 5 degrees 30 minutes south latitude.

"In latitude 10 degrees 58 minutes south we struck the mouth of a big affluent flowing from the right and in latitude 9 degrees 49 minutes south we came to the mouth of another affluent flowing from the left.

"The Duvida River in point of volume is like the Rhone, the Elbe, or the Hudson, but is too much broken up by rapids to be navigable except in the lower parts. In about 7 degrees 30 minutes south latitude it joins another river, practically the same size, flowing from the right.

"From about 11 degrees 48 minutes to 10 degrees 48 minutes south latitude the course of the Duvida is almost an unbroken series of rapids, there being no clear day's run without rapids."

Though not questioning Roosevelt's good faith, several geographers have expressed doubts as to the accuracy of the statements above quoted. The Madeira River, of which the Duvida is said to be a tributary, is not only well known, but regularly navigated by steamers far above the point where the Roosevelt party claims to have entered it from the newly found river. How could this great tributary have hitherto remained unknown to the many people who travel up and down the Madeira? An unnamed explorer whose views are quoted at length in the English press suggests that the Colonel may have sailed down the Tapajos, while Sir Clements Markham is inclined to think that he descended the Canuma, the greater part of which has never been explored. In either case, as he undoubtedly entered the Amazon by way of the Madeira, he must have reached the latter by some unknown cross-channel, or, according to one suggestion, by way of a temporarily flooded lowland. The journey was made at the close of the rainy season, when, as is well known, South American rivers indulge in curious freaks.

The best maps of the Amazon region, such as Mello's "Atlas do Brazil," the large Olavo Freire map, and the great German atlases of Stieler, Andree, etc., throw little light on this question; in fact, a comparison of these maps with one another shows unmistakably that the cartography of the whole region where the Duvida is supposed to run is, at present, merely conjectural. The reported starting-point of the canoe journey corresponds closely with a supposed upper portion or branch of the Jamary, a tributary of the Madeira, and the relief of the country in this immediate vicinity negatives the probability of the explorers having entered the drainage system of the Tapajos. It is, however, by no means certain that the river shown at this point (on most maps by dotted lines) is really connected with the Jamary. It may well be the Duvida. Following the alleged course of the latter northward we find only one cartographic feature inconsistent with its existence, viz., the Rio Machado, which if correctly shown on the maps, would intersect it at right angles. Here, again, however, we have to do with a river whose course is largely a matter of rumor and conjecture.

What at first sight appears to be a serious objection to the explorer's claims, viz., that so important a tributary of the Madeira would have been well known long ago to navigators of the latter river—is easily disposed of by reference to Roosevelt's description of the Duvida. A river broken by innumerable rapids and exceedingly difficult to navigate even in a canoe might well have remained unexplored [illegible] Most of the streams entering the Madeira from the right are shown on the best maps by dotted lines, except at their immediate junctions with the main river; and one of these is, in all probability, the [illegible]

We believe that the Roosevelt [illegible] a notable addition to the map of [illegible]

[illegible]

[illegible].—Unostentatiously and [illegible], the world's trade through the Panama Canal is shortly to be inaugurated by the passage of a mail steamer of about 5,000 tons from the Pacific to the Atlantic. The clearing of the [illegible] slide has proceeded sufficiently far to allow of the passage of a ship of this size. The opening was hastened forward by the congestion of freight due to the closing of the [illegible] Railway.

Barges for the New York State Canal.—The New York State Barge Canal will have a capacity to pass barges of 2,000 net tons. The dimensions of the barges will be: Length, 270 feet; beam, 35 feet; and draft, 12 feet. The total lift through locks of the Barge Canal is 16 times that of the Panama Canal, and it has 10 times the number of dams, 14 times as many locks, and 20 times as many structures. The cost, as far as construction and engineering is concerned, will be within the estimated cost—a fact for which full credit should be given.

A Fatal Omission.—One of the greatest needs of the Navy just now is the large drydock which is under construction at Pearl Harbor, Hawaiian Islands. During the recent debate on the Navy Bill in the House, however, the "little navy" men succeeded in casting out the provision for this dock, on a point of order. This makes it impossible for the contractors or the Navy Department to complete the construction of this most important work. Apart from the urgent need for the dock, it is a fact that unless the provision is put back in the bill in the Senate, the Government probably stands to lose all the money it has expended on this improvement.

Zoelly Turbine Installation.—The recently constructed electric station for the city of Paris in the suburbs at St. Ouen, employs among others two steam turbine groups designed by the Société Alsacienne. These turbines are connected to alternators on the same shaft. Of the Zoelly type, the present turbine develops 15,000 horsepower and operates at 1,250 revolutions per minute. By the automatic working of a by-pass, it is able to develop 50 per cent above the normal for a short time. The Zoelly wheel works on the impact principle, and the present design allows of adopting periphery speeds which are relatively high. Wheel disks are forged in a single piece with the hub, and the blades are dovetailed around the edge of the disk.

The Most Powerful Locomotive.—What is probably the largest sudden increase in the size of locomotives has taken place in a new freight locomotive, built by the Baldwin Works to serve as a pusher over heavy grades on the Erie Railway. The engine is of the Mallet articulated type; but its weight and power have been greatly increased by adding a third pair of cylinders and a set of six-coupled driving wheels, which are carried by the frame of the tender. The boiler has 6,886 square feet of heating surface, and the steam is utilized in one pair of high pressure cylinders and two pairs of low pressure cylinders, all of which are of 36 inches diameter by 32 inches stroke. The working pressure is 210 pounds to the square inch, and the drawbar pull is 80 tons. The total weight is 477½ tons, of which 376½ are upon the drivers.

The Location of the Alaska Railway.—Now that the Government has decided to build the Alaska Railway, one of the first questions to be determined will be that of the selection of the engineer to lay out the best location for the road. The locating of a new line is the most important work that the engineering staff of a new railroad have to do. The locating engineer is a specialist. Upon his good judgment depends the question as to whether the completed road is to cost so many million dollars more or less; and in the selection of the man for this work, political considerations should have no weight whatever. If the Government wishes to show how well it can lay out, construct and equip a railroad, it should select its staff entirely upon their merits, that is to say, upon the work which they have done under conditions approaching those which will be met with in Alaska.

Combined Rack and Adhesion Locomotives.—The railroad line running between Usui and Toge is obliged to run upon very heavy gradients when on the mountain, the difference of level being some 1,760 feet over a length of but 7 miles. On this portion there was used a rack-rail system of the Abt design and some 20 locomotives specially employed for the mountain stretch, ordinary locomotives being used on the other parts of the railroad. Lately the steam locomotives were replaced by electric locomotives of the Allgemeine type, designed to run on 600 volts continuous current with third rail. The locomotives are designed on the combined adherence and rack-rail system, and are said to be the most powerful rack-rail electric locomotives yet built. The electric motors are mounted on the car floor, and drive a counter-shaft by gearing, whence a driving bar system operates the wheels. The rack wheels are driven by a separate [illegible].

Science

Water-Proofing Concrete.—The United States Army Engineers have long used the following mixture in waterproofing cement: One part cement, two parts sand, three quarters pound of dry powdered alum to each cubic foot of sand. Mix dry and add water in which has been dissolved three quarters pound of soap to each gallon. This is nearly as strong as ordinary cement, and is quite impervious to water besides preventing efflorescence. For a wash, a mixture of one pound of lye and two pounds alum in two gallons of water is often used.

Teak Forests in Java cover 1,480,000 acres, and, as the area reafforested is two and a half times as large as the area felled in a given time, this magnificent stock of timber is continually increasing. A pest of the Java teak plantations is alang grass (*Imperata arundinacea*). In order to prevent the incursions of this plant, as hoeing is too expensive, the foresters sow a leguminous plant, *Leucena glauca*, between the rows of teak seedlings. This chokes the alang, keeps the soil clean, and enriches the soil in humus and nitrogen, and ultimately disappears with the increase of the forest cover.

Some High Ocean Waves.—Regarding the greatest height of waves reported by different observers, Lieut. Raffi of the "Jules Henry," recently noticed waves of 66 feet in the Atlantic. But this does not appear to be the highest on record. In 1863 Admiral Fitz-Roy affirmed in his "Weather Book" to have seen waves of 60 feet. Capt. Kiddle of the "Celtic" observed 70 feet height, and the same figure is also reported by the commanding officer of the "Narrung" in the region of the English Channel during the tempest of last winter which prevailed on the Channel and the North Sea. It is not stated how the observers estimated the height of the waves, so that some latitude must be given on this account.

Metals at Absolute Zero.—Prof. Dien has recently published some interesting observations on the behavior of metals at the absolute zero of temperature. The infinite electrical conductivity of metals at absolute zero, which has been rendered very probable by the work of Kamerlingh Onnes, is explained if we assume that the distribution of molecules at the lowest temperatures is perfectly regular, so that the displacement of electrons along certain lines encounters no resistance. By increasing the temperature, the molecules are set in a state of thermal agitation and the free path of the electrons is reduced; whence the electric conductivity is reduced also. It appears probable that temperature variation affects only the mean free path and not the number of electrons nor their mean velocity.

Increasing the Yield of Gasoline from Petroleum by Use of Catalytic Nickel.—An English company is securing a very large yield of gasoline from petroleum by catalytic hydrogenation. The method is practically the same as that recently applied in the conversion of liquid fats to a solid form or to solid fatty acids with a higher value. A tall still with a conical bottom receives a steady feed of petroleum and hydrogen gas under pressure. This mixture enters at the bottom and passes over finely divided nickel which catalytically brings about a reaction between the hydrogen and oil. Gasoline is formed which passes off as a vapor at the temperature of the still, while the heavier hydrocarbons formed fall back into the catalyst and react with hydrogen. Finally a tarry residue must be removed and the nickel regenerated. The issuing gases pass into a cooling chamber where the gasoline is condensed. The hydrogen unused up to that point is forced back and passed through the still once more. The efficiency of the process is very high.

The Colors of Odoriferous Plants.—Messrs. Schubler and Koehler have published the results of some very interesting observations they have undertaken on the relations between the colors and odors of various flowers. They have analyzed more than 4,200 plants, and they find that: (1) white is the most common color for flowers, and (2) that red, yellow and blue are more general than violet, green, orange and brown. The different odoriferous species divide themselves among the different colors in the following manner:

Color of Flowers.	Number of Species Examined.	Number of Species Having Odors
White.........	1,194	187
Red.........	933	84
Yellow.........	950	77
Blue.........	594	31
Violet.........	308	13
Green.........	153	24
Orange.........	50	3
Brown.........	18	1
Total.....	4,200	420

As will be seen, the number of plants possessing odors is only one tenth the total number of species. We also see that in proportion, it is among the white flowers and then the red that we meet the greatest number of odorous plants.

Aeronautics

A New Aeroplane Stabilizer.—W. E. Verclaire, of Chicago, Ill., in a patent, No. 1,093,746, provides for tilting the planes in which the propellers rotate to agree with the tilting of the stabilizing planes in order to facilitate the control of the aeroplane.

A Gas Container that Forms a Parachute.—Albert A. Callicotte, of North Yakima, Wash., has patented, No. 1,092,973, an airship in which the gas container is shaped as a parachute. Horizontal and vertical tubes are provided in which are arranged the propelling and elevating means.

The Aeroplane and the North Pole.—The report comes from Berlin that Capt. Roald Amundsen has completed a course of training as an air pilot at Johannisthal. He will take with him two aeroplanes on his polar expedition, hoping to reach the pole by air after travel by sea becomes impossible.

Hirth's Flying Machine.—Hellmuth Hirth, the well-known German aviator, has secured patent No. 1,094,898 for a flying machine, the different parts of which are arranged so that the lifting power may be rapidly and easily adapted to the load carried, and the speed of flight to the local circumstances, for instance, those present in landing.

A Tax on Aviators.—An entry and circulation tax upon aviators in Germany is not likely to be favored in aeronautic circles. It is now being considered by the Foreign Office, and applies to all outside aeroplane pilots with their machines, somewhat like the rules which exist in Alsace-Lorraine as concerns automobiles. The tax will be $12.50 and even $25 per pilot, regardless of whether he enters by railroad or by actual flight.

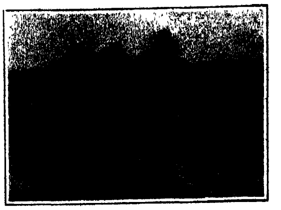
An Aeroplane Review.—During the visit of the English sovereigns to Paris, one of the interesting events was the army review held at the Vincennes military grounds, and on this occasion aeroplanes were out in force. During the maneuvers pilots made a sham attack upon the airship "Montgolfier" which is the "Clement-Bayard VI." rebaptized, and as the airship itself is remarkably easy to handle, such an attack brought out the pilots' skill, and showed what we might expect in real war. The whole maneuver was a great success and is a very novel performance with the two kinds of aircraft. Farman biplanes were used entirely in this case, most of them equipped with De Dion motors.

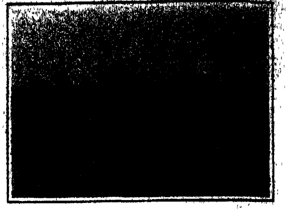
The Russian Programme.—According to latest news about military aircraft matters in Russia, it appears that the war department has made a number of changes in the programme which is proposed for construction of new aeroplanes. The new programme in fact calls for building 100 aeroplanes of the Deperdussin, and the same number of the Morane type, as well as 40 Farman aeroplanes, making 240 flyers in all. On the other hand, the number of Sikorsky aeroplanes which are to be built by the Russo-Baltic establishment is considerably reduced, for at first it was proposed to build about 100 flyers of this type, but the present programme calls for only 45. Of this number, 25 will be biplanes, 13 monoplanes, and the remainder will be used as teaching apparatus without motors.

Aviation in Russia.—The general assembly of the committee of the Russian aerial fleet was held not long since, presided over by Grand Duke Alex. Michailovitch, and it was decided, first, to organize corps of aerial militia which will add volunteer aeroplane pilots in order to reinforce the army and navy fleets; second, to establish military aviation stations provided with strong electric searchlights; third, to form a corps of aeroplanes which are to act as a reserve in order to supply the main fleet with all that is necessary in time of war. As regards Russian aeroplane events, we note that Prince Abamalek has offered a prize of 10,000 roubles for a successful flight from Sebastopol to St. Petersburg during May or June, the trip to be made within 24 hours. Although this time may appear short, it is claimed that during the good weather that prevails at this season, the trip can be made without undue difficulty in that length of time.

Armored Aeroplanes for France.—A fleet of armored aeroplanes is being prepared for the use of the French army, according to recent statements made by the Minister of War, and it is designed to serve mainly for scouting purposes. Before long a fleet of the new aeroplanes is to start from the Chalais-Meudon establishment for the Mailly camp where the final trials are to take place. Such flyers are biplanes and have two places, being built according to Comm. Dorand's designs. The armored body or fuselage holds pilot and passenger who are protected by a 2½-millimeter steel plating, and it is claimed that it cannot be penetrated farther than 2,500 feet. In front is the motor of 85 horse-power size, and the speed will be about 60 miles an hour. According to a well-known expert, the present flyers are the only armored aeroplanes that have been able to satisfy the requirements for this class of flyer. Six aeroplanes will make up the present fleet, and they will be manned by well-known pilot officers.

One of the screw type guy anchors.


Making fast to the shifted track.


The track restored to the original position.

Hauling a Flood-swept Railroad Back to Line

SECTION gangs on the Louisville and Nashville Railroad last spring performed the unique feat of hauling back into place six miles of railroad track that had been washed away by the floods. For about three miles on either side of the Wabash River the high water had not only shifted the tracks and ties, but in some places had upended them against the telegraph poles, so that they resembled a grotesque picket fence that had been hit by a cyclone.

The method used in working the track into position while the waters were still running over the right of way was as follows: A dozen 12-inch guy anchors were rushed to the scene of trouble, the sort that can be screwed into the ground, and offer a secure anchorage against heavy strains. With the water running from a foot and a half to three feet deep, these anchors were screwed into position along the shifted railroad tracks, upstream from the right of way. A block and tackle was passed through the eye of each anchor and around the railroad track and then twenty or thirty laborers would tug on the fall line until the section was slowly worked into position. It was then staked down to prevent further shifting, the anchors were unscrewed and the operation was repeated. Not only the dead weight of tracks and ties, but the resistance of the current made a terrific strain on the devices thus brought into unexpected use, but they proved to be decidedly effective, so that about two thousand feet of track was relaid every day, as against six to seven hundred feet by previous methods.

The photographs show the details of the operation and indicate the unusual difficulties under which the section hands were operating.

Electric Towing Locomotives for Panama Canal Locks

THE first lot of electric towing locomotives for hauling vessels through the locks of the Panama Canal are now being received at the Isthmus. In all, forty of these "electric mules" are being built by the General Electric Company for this purpose. The machines weigh 82,500 pounds; measure 32 feet 2½ inches long by 8 feet wide by 9 feet 3 inches the greatest height over the cabs; have an available tractive effort as high as 47,500 pounds and a windlass rope pull of 25,000 pounds, and four of them, two on each side, will ordinarily propel steamships through the locks. Sometimes six engines will be needed to handle extra large vessels; in every case two astern, acting as a brake on the ship's movements, will give direction to her course. No vessel will be allowed to enter the locks and go through on her own power.

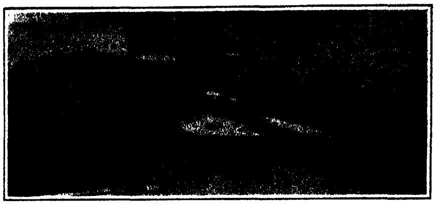
The locomotive is propelled by means of a rack rail while towing and while going up or down the steep grades from one level to another at a speed of 2 miles per hour. While running idle or on return tracks, the speed is changed to 5 miles per hour, and the machine is propelled by the regular traction method, the rack pinion being entirely released. This change is effected by manually-operated clutches located in the gear mechanism in connection with a lever in each cab similar to a steam locomotive.

The locomotive is driven by two 75 horse-power totally inclosed motors of the mill type, one being direct connected through reduction gearing to each axle. Three-phase, 25-cycle, 220-volt current is used, and is collected by contact plows. The motor and traction gearing is mounted on a common base-plate, which in turn is mounted on a driving axle and spring suspended to the locomotive frame the same as in regular railway practice.

One of the towing locomotives for the Panama Canal locks.

In the center of the locomotive is located a vertical windlass with drum, the capacity of which is 800 feet of 1-inch steel hawser cable. The windlass, with its driving motors and gearing, is mounted on a solid base-plate, and is likewise independent of the movement of the locomotive frame. The cable drum extends above the locomotive cover and has a floating guard placed around it to retain the cable while coiling loose.

The windlass cable is handled by two 20 horse-power motors, also totally inclosed and of the mill type. One is geared for a rope speed of 12 feet per minute at a pull up to 25,000 pounds at 2 foot radius, and its function is to adjust the position of the ship for anchor or while being towed through the locks. The other motor is geared for a rope speed of 200 feet per minute at 2-foot radius, and its duty is to take up slack or pay out cable or wind in any part of the entire length of cable as may be required. The cable drum is driven through a friction device which can be set at any desired value from zero up to the full capacity of the motor.


Copyright by Branger

Freak flying machine built on the principle of the boomerang.

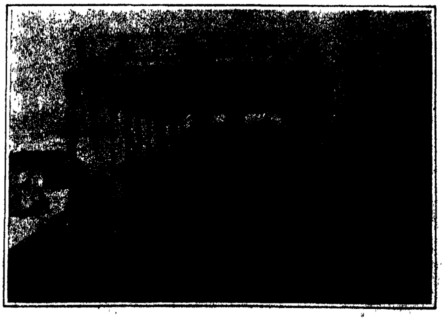
A "Boomerang" Flying Machine

TWO French engineers, A. Papin and D. Pouilly, are responsible for a new departure in aeronautics—a departure that has not yet departed from the solid earth. They explain that in designing their machine they had before them mainly three purposes: To provide a device which could rise from the ground without preliminary "run," and which could similarly alight on a selected spot; to furnish a machine that could at will either advance through the air or be held stationary; to provide for a slow descent in case of failure to the motor.

The apparatus is designed on the principle of the boomerang, or, to use another illustration, of the maple seed, which represents a natural example of a screw propeller revolving about an imaginary axle and capable of assuming different inclinations. The fall of the maple seed is familiar to all, how it slowly descends, revolving about its axis as it does so. If the direction of its rotation were reversed by the application of suitable power, the seed would rise instead of falling.

Our illustration shows the new "flying machine." It constitutes a huge single blade screw propeller with a spread of 178 feet. The blade *A* and the central body *B* are hollow, and through them a stream of air is blown by a fan *C*, driven by a motor *D*. The motor is an 80 horse-power, nine-cylinder gasoline engine, and is manipulated by compressed air controls from the car, which does not participate in the rotation of the rest of the machine. The blast of air escaping from the curved tip of the propeller at *G* causes it to revolve by impulse reaction. The car *J* is mounted on ball-bearings. Over it is situated a hollow antenna *K*, the tip of which is curved in the direction opposite to that of the tip of the propeller blade. Through this hollow antenna a blast of air is also blown, issuing at the nozzle *L*.

The new device is, without doubt, interesting—from a psychological point of view. But—will it fly? Perhaps this is a secondary consideration.

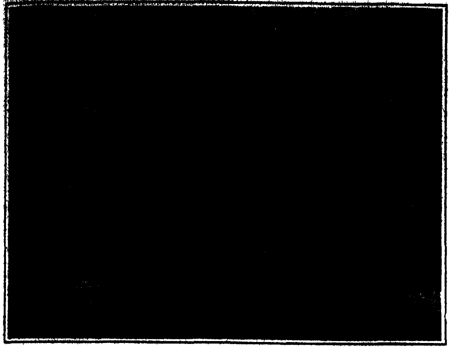

Sight-seeing barge for the Panama Canal.

Sight-seeing Barge for the Canal

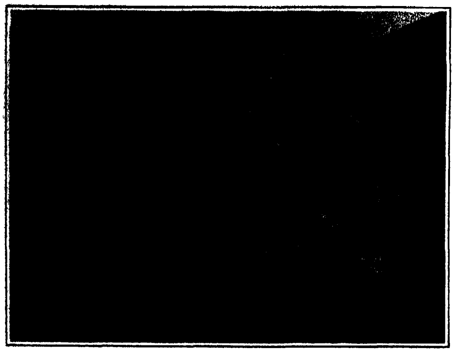
THE greatest sight-seeing conveyance for public use is the passenger carrying barge fitted up to make trips through the Panama Canal. Its foundation is a steel dump barge, brought to the Isthmus in 1909, which is 154 feet long, with a 32-foot beam, 10 foot 7 inch depth. It has a gross displacement of 509 tons.

Like the familiar sight-seeing automobiles, the seats are arranged in tiers, gradually descending from a height of 8 feet 9 inches in the rear to 2 feet at the forward end, and there is also standing room for the passengers on the roof.

The Paper Used by the Government printing office each year requires approximately 125 million pounds of rag pulp and 490 million pounds of wood pulp.



The main saloon, which is entirely free from columns.

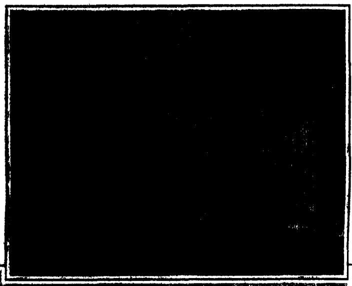


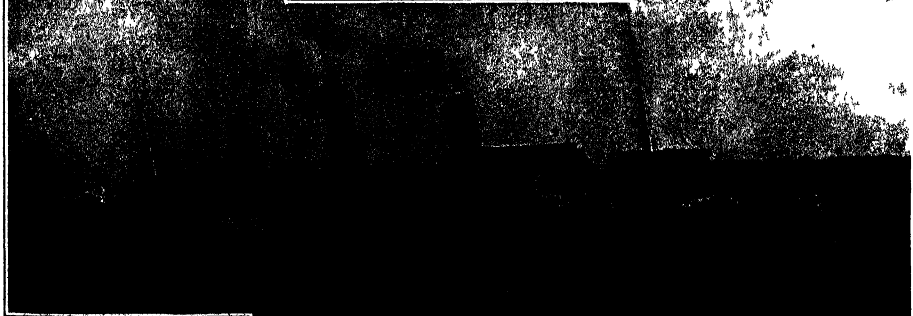
A notable feature is the Pompeiian swimming pool

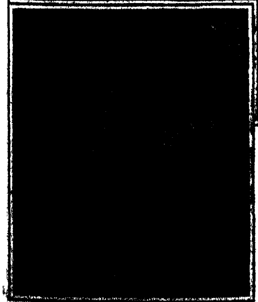
The World's Largest Steamship

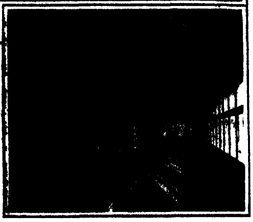
Maiden Voyage of the Steamship "Vaterland," to the Port of New York

WITH the launching of each 'largest steamship it was customary a few years ago to say of her that the limit of size had been reached and that in future there would surely be a return to more moderate dimensions. To-day, we hear no such prognostications for the dimensions so far from diminishing give promise rather of increasing It was less than one year ago that there steamed into the port of New York the Imperator' of the Hamburg American Line—the first ship to exceed a length of 900 feet her length on deck being 909 feet and her displacement 52 000 tons. This week sees the advent of the Vaterland of the same company a huge ship which exceeds the Imperator' in length by 41 feet in beam by 2 feet and in displacement by no less than 6 000 tons









The dining room seating eight hundred people

The "Vaterland" leaving Hamburg for her trial trip.
Length 950 feet; beam, 100 feet displacement 58 000 tons

Cruiser stern and balanced rudder.

A stretch of deck, showing wind screens.

The Vaterland whch was built at the yards of Blohm & Voss, Hamburg, is 950 feet in length 100 feet in beam and she displaces 58,000 tons. We are informed bv the company that during a trial cruise of over two days' duration she averaged a speed of 25.8 knots, her turbiues developing 90,000 horse-power In view of the fact that she was announced as a 23-knot ship this is certainly a most surprising result, although the great work which has been done by her builders in the construction of high-speed German armored cruisers propelled by similar motive power, all of which greatly exceeded their contract speed, should have prepared the public for very fine steaming results in this vessel Thus the Von der Tann designed for 25 knots made on a recent trial 28.1 knots the Moltke and Goeben designed for 27 knots on recent runs made respectively 28.7 and 28.6 knots The motive power of the Vaterland is broadly similar to that of the cruisers consisting of four turbines driving four propellers

As compared with the Imperator which was built at the Vulcan Works the Vaterland to the eye of any but the expert looks to be practically identical her increase in length of 41 feet being scarcely perceptible on a ship of such great dimensions Her under water form however and the construction of the hull at the stern are quite different the Vaterland having what is known as a cruiser stern with a balanced rudder which is entirely below the waterline The form of the

"Vaterland" also differs greatly from that of the "Imperator," the successive water planes aft being fuller than those of the earlier ship. We understand that the changes in her model, as compared with the "Imperator," had much to do with the high speed which she achieved on her trial. A feature which adds to the appearance of the ship is the absence of the monster eagle which is carried at the bow of the "Imperator." An eagle makes an appropriate figurehead on a clipper-bowed ship; but it is inappropriate and quite inharmonious when placed at the top of a straight stemhead such as characterizes the modern transatlantic liner. The shield and scroll work of the "Vaterland" are in better taste.

The "Vaterland" is constructed with both longitudinal and transverse bulkheads, the longitudinal bulkheads forming the inner walls of the coal bunkers, and serving as an inner skin. All the walls of the passenger decks have been coated with special fireproof material. The bulkheads are of unusual stiffness, and the openings in them, where they pass through the passenger accommodation, are closed by fireproof glass doors, thirty-nine in number, which will withstand a temperature of 1,000 degrees. The staircases are so encased with fireproof material that each forms a fireproof inclosure. A special fire department, composed of trained fire fighters, devotes its entire attention to fire protection. It occupies a special cabin, where all the fire alarm signaling devices are centered. There are more than 450 fire announcers throughout the ship, which would instantly indicate a dangerous rise of temperature. A complete system of automatic fire sprinklers, comprising 800 water jets, is distributed throughout the crew's quarters. A special fire fighting device employing chemicals in place of steam is operated by the firemen. There is also a complete system of fire hose and pumps. The fire fighting installation fulfills the strictest rules laid down by the German building and police authorities. The "Vaterland" carries eighty-four lifeboats, including two motor lifeboats, which more than accommodate all on board.

The several cabins of the "Vaterland" have been designed by the leading decorators of Europe; and the great liner with its paintings, sculptures, and decorations affords an interesting study of the decorative arts. The grand dining saloon, which seats 800 guests, is finished in white and gold, its ceiling being supported by Ionic columns. In contrast to this the Ritz Carlton is carried out in mahogany and walnut, decorated with heavy garlands in bronze. The smoking-room is paneled in Flemish oak in low tones, while the main lounge, which may be converted into a ballroom, is decorated in warm red tones. The art treasures include paintings by old Italian masters as well as work of many notable contemporary artists. On the main staircase hang two landscapes by the Venetian artist, Giovanna Battista Pittoni (1690-1767). Four large canvases by Lairesse adorn the main saloon; and a portrait of King Ludwig of Bavaria, by Baumgartner, will be found in the ladies' saloon. The smoking-room is enriched by two marine studies by Prof. Schnars-Alguist, while a great panoramic study, by Kolmsperger, adorns the cupola of the dining-room.

The Death of Paul Louis Heroult

A PRIVATE cable to students of the Massachusetts Institute of Technology announces the death in Paris on Saturday of Paul Louis Toussaint Heroult, whose name will ever be connected with aluminium and the electric furnace. The name is familiar in Boston in that his son Paul was a student at the Massachusetts Institute of Technology from 1910 till 1912, going home at the end of his sophomore year for his service in the army. He was particularly active in athletics, being on the tug-of war team, second in the pole vault and one of the wrestlers.

Heroult *pere* was born at Thury-Harcourt, and had his boyhood schooling about equally in England and France. He went to the Lyceum at Caen and later to St. Barbe, Paris. In 1882 he attended the School of Mines in Paris, and the next year took his military service in the army. On finishing this he went with a metallurgical firm, and giving his attention to aluminium, in 1886, two years thereafter, he obtained a patent for the production of this metal electrolytically. On his discoveries are based the improvements in methods that brought the price of the metal from $20 a pound in 1884 to about 50 cents in 1901.

The more recent achievements of Heroult have been in the line of the electric furnace for steel, aluminium and other metals. His principal work here was the introduction of two electrodes into the melting-pot, so that the ore received the full effect of the heat and the furnace was little more than a container. A later improvement consisted of a third electrode, which was in the nature of a starter and which burned away when the furnace rose to its proper heat. For his furnace he received in January, 1904, the medal of the French Society for the Encouragement of National Industries. The Heroult furnace is in extended use to-day in many places, while for Canada he made a special investigation with the nature of the local ores in view.

Do Plants Sleep?

By Maud DeWitt Pearl

WE ordinarily think of the ability to sleep as something belonging exclusively to the animal kingdom. Whether plants likewise enjoy a daily period of rest has recently been studied by a distinguished Indian botanist, Prof. Bose, of Presidency College, Calcutta, India. He worked with the sensitive plant, *Mimosa pudica*. An electrical apparatus was constructed, which, at regular intervals throughout the day and night, gave a slight but constant shock to the plant. When the plant responded to this stimulus it drooped its leaves and stems. Then, after a period of quiescence, it gradually returned to its original condition. The degree of response to the electric current and recovery to the normal condition were recorded upon a smoked glass plate by means of a tracer attached to the apparatus, so that an hourly record was obtained, for many days and nights, of the state of the "motor-excitability," as Prof. Bose terms it, of the plant. The results which were obtained show that Mimosa is in the Land of Nod, regularly, every day. What is true of Mimosa is undoubtedly true for plants in general.

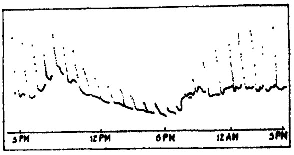


Fig. 1.—*Diagram showing response of Mimosa to stimulation during a period of twenty-four hours.*

If it had not been for Prof. Bose's experiments, however, no one would have suspected that plants are guilty of disobeying the old adage of "early to bed and early to rise," etc. But the experiments show Mimosa to be a very late sleeper. At nine o'clock in the morning the plant is practically unresponsive when stimulated by the electric current. From this time on, however, there is a gradual awakening until at noon the maximum response is reached. This continues until about five o'clock in the afternoon, when the fluctuation toward the opposite condition sets in. The motor-excitability gradually diminishes until the minimum state is reached at about nine o'clock the following morning.

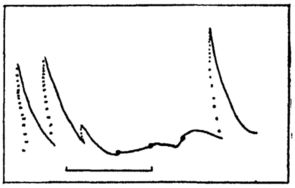


Fig. 2.—Response when subjected to sudden cold.

This variation of the motor-excitability of the plant is due to the combined effect of light, temperature, and moisture. During the night the temperature is lower, the stimulating effect of light is withdrawn, and the plant becomes more turgid, owing to its not giving off so much moisture. Since the effect of these factors upon the plant is cumulative and at the same time there is a lag in the response of the plant to them, we have the explanation of why Mimosa is in a state of lethargy so late in the morning. Likewise, why the plant is in the opposite condition late in the afternoon when night is fast approaching.

The accompanying drawing, Fig. 1, shows the state of excitability of Mimosa during a period of twenty-four hours when stimulated regularly by the electric current. The diagram is read from left to right. The uneven base line is due to the regular leaf movements which the plant exhibits daily and is not related to the response of Mimosa to the electric current. The downward curve represents the gradual recovery from the stimulus. It will be noted that the plant is markedly excitable from 12 A. M. up to about 9 P. M. From this time on there is a gradual [illegible] stimulation until late in the morning, when the plant shows no excitability whatever. After this time the recovery is quite rapid up to 12 A. M., when the [illegible] of excitability is reached.

Fig. 2 shows the amount of response to the electric current when subjected to sudden cold. The dotted upward lines indicate the degree of response to the stimulus, the smooth downward lines, the recovery. It will be noticed that after the plant is exposed to sudden cold the first response to the current is much lessened, and the second and third stimulations produce no effect whatever. The ordinary temperature is then resumed, but the plant still exhibits the after-effects of the cold.

Setting a Watch

By Frederick R. Ward

THE accurate time signals sent out by wireless at noon and at 10 P. M. from the Government station at Radio, Va., have stimulated the interest of those who are equipped with receiving apparatus in keeping their watches closely regulated and set.

Watch movements as good as the 17 jewel grade, and costing about $15, may, by careful adjustment of the regulator, be made to keep time to within thirty seconds per month; so that, if a curve be plotted on cross-section paper showing the error of a watch, each time it is checked by the wireless signal, it is possible to estimate closely what the error should be at any given time.

Since, however, an exact adjustment of the regulator is impossible and the error gradually increases until it becomes inconveniently large, it is often desirable to reset the hands. The usual method of doing this, by stopping the balance wheel with a toothpick and letting it go at the right moment, is inconvenient unless there be another time-piece at hand and is also open to other objections.

The author has discovered a method of bringing the error back to zero, or of setting a watch accurately without disturbing it in any way. If the chain or fob be removed, and the watch be hung up by its bow on a hook or nail driven in the wall, so that it hangs free, it will be found to swing itself slightly, pendulum fashion, by reason of the motion of the parts of the escapement. The effect of this swinging on the running of the watch varies between individual watches and depends on the weight of the case and on its dimensions. As a rule, it will be found that a watch gains about two seconds per hour, though some of them show a loss, instead. The exact amount must be found by trial, say, by hanging up the watch for ten hours and checking it against the wireless signal. Once this value is known it is obvious how it may be used to advantage. If the watch *gains* when hung up, the regulator should be adjusted so as to make it run a trifle *slow*. Then when the accumulated error becomes inconveniently large, the watch may be hung up on the hook, say at night, for the right number of hours to bring its second-hand ahead to the correct position.

Should a watch be found of such weight and dimensions as to neither gain nor lose when hanging as described, it can be made to respond by hooking on a piece of metal at the base of the stem, thus raising the center of oscillation of the swinging mass. For the same reason a hunting-case watch has a different rate when hung with its case open from the one when the case is closed. It is an added convenience to know both these rates, since sometimes one is positive and the other negative, thus enabling one to set the watch either forward or backward at will.

Our Front-cover Illustration

AS evidence that the giant ocean liner is profitable, it should be noted that there are five vessels of 900 feet length and over building or under construction. These are the "Vaterland," 950 feet; "Imperator," 900 feet; a sister to the "Vaterland" building at Hamburg; the "Aquitania," 900 feet, which will reach New York in June; and the "Britannic," 900 feet, shown on our cover, due here next Autumn.

The Current Supplement

IN this week's issue, No. 2008, of the SCIENTIFIC AMERICAN SUPPLEMENT, E. R. Matthews contributes an illustrated article on the effects of wave-action upon harbor breakwaters and piers.—E. H. Ross writes on Houseflies and Disease.—H. J. Spinden tells us the story of an interesting chapter of ancient American history.—Bashford Dean writes on the habits of fishes, as illustrated by exhibits in the American Museum of Natural History.—A paper read by W. A. Hargreaves before the Society of Chemical Industry on "Blasting Gelatines" is reported in full.—A timely topic discussed is that of disease danger in the invasion of Mexico.—The use of trees as windbreaks for farms is illustrated and described.—A chart prepared by C. H. Clark shows at a glance the [illegible] to transmit a given horsepower at [illegible]

The Fallacy of the Combined Aeroplane and Dirigible Balloon

By [illegible]

THE reason for proposing a combination of balloon and aeroplane is not hard to find. Probably the inventor reasons something like this: "The aeroplane is inexpensive, compact and speedy; but it is unsafe, and will not carry much weight. The dirigible is big, clumsy, expensive and slow; but it is safe, and it will carry a comparatively large weight. Let us combine the two principles in such a way as to get the advantages of each without the disadvantages. Let us attach to an aeroplane a balloon bag which is large enough to carry part of the weight and let the machine down slowly in case of accident, but will not be so big and offer such resistance to speed as a regular dirigible which has to lift all of the weight unassisted. Then the aeroplane will also be big enough to carry the machine safely to the ground in case the balloon explodes."

This is what is generally meant by a "Combined Aeroplane and Dirigible"; that is, a combination, each unit of which can carry a considerable part or all of the weight. Aeroplane surfaces on dirigibles for steering purposes, or as a substitute for ballast, are in an entirely different class and are practically necessary in some form. Then there is the entirely feasible, though perhaps not practicable, method of *balancing* an aeroplane by means of a balloon; these forms will be considered outside of the present sphere of discussion.

The arguments given above for the combination machine might seem very reasonable. They are. The only trouble is that it doesn't work out that way. The argument is all right, but the premises are wrong. Most of the fallacies in such a scheme arise from disregarding one or more of the following laws:

1. There is no object in combining two *different* methods for attaining a given result unless some added advantage peculiar to such a combination is gained. Thus you wouldn't ordinarily hitch a gas engine and a steam engine in tandem to drive a dynamo, but would select the most efficient unit for that particular work, and use it exclusively. On the other hand, the combination of a reciprocating engine with a turbine is often better than either one alone because, although not so efficient at high pressures, the turbine can get energy out of the exhaust steam which would otherwise go to waste.

2. The volume and hence the lift of a balloon varies as the cube of its outside dimensions. Much trouble is caused by a misconception of the size necessary to lift any considerable weight. There *are* balloons which will carry a large weight but they are all very much bigger than any aeroplane ever attempted. A dirigible 260 feet long by 50 feet in diameter will lift a total of 26,000 pounds when inflated with hydrogen. A balloon one tenth these dimensions would be 26 feet long by 5 feet in diameter, comparable in size to the ordinary aeroplane; yet it would barely lift itself, a total of 26 pounds.

3. For small sizes, the resistance and weight of a balloon vary as the square of its outside dimensions.

4. It takes exactly as big a balloon to keep a given weight from falling as it does to lift it. As a close corollary to this, we have that it takes nearly as much gas to let a weight down easily as it does to lift it.

5. The lift of an aeroplane varies as the square of the dimensions while its weight and resistance (for structural reasons) must vary by a little more than the square. Furthermore, the efficiency of a surface is very much impaired by extending or multiplying it from front to rear, which is just the opposite to the case of the dirigible. (In spite of this, the aeroplane can probably be developed considerably above its present size.) The efficiency of an aeroplane decreases slightly with increase in size. Not so with the dirigible. It is fundamentally and always will be a large machine. The results to be gained by even a moderate increase in size are almost inconceivable at first; but it is founded on strict elementary laws which cannot be ignored any more than the existence of gravitation.

As an actual example, let us figure out roughly how much we can improve an ordinary Wright aeroplane by the addition of a cigar-shaped balloon which will lift half the weight. I think we may take the performance of the aeroplane alone about as follows: Horse-power, 30; speed, 40 miles per hour; resistance (thrust) 180 pounds; efficiency of power unit, 64 per cent; total weight with fuel and 2 passengers, 1,000 pounds.

Take away half the supporting surface, which might reduce the weight to 800 pounds, and the resistance to 120 pounds, for the same speed. A balloon 60 feet long by 12 feet diameter would have a total lift of 780 pounds when fully inflated with hydrogen. Its weight with suspension cords, framing and accessories would be in the neighborhood of 380 pounds, thus leaving 400 pounds for lift, or half the weight of the reduced size aeroplane. Its resistance, with extra bracing, etc., would be close to 300 pounds at the 40 mile speed. The speed of the combination would be cut down in consequence to about 20 miles per hour, and the lift of the aeroplane to 170 pounds. We lose, in this way, 230 pounds of lift that we had counted on from the aeroplane. It means that instead of cutting down its size to meet the new conditions, *we should have actually increased it* by 3 or 4 times its original area. After making these corrections, we get final results something as follows: Speed, 20 miles per hour; total weight, 1,600 pounds; lift of gas-bag, 800 pounds; lift of aeroplane, 800 pounds.

We have reduced our speed to one half that of the original aeroplane. We have a machine which is clumsier, more expensive and slightly less speedy than a regular dirigible of equal power and passenger carrying capacity. Certainly such a sacrifice should be accompanied by some very great advantage, but where is it? Take the matter of safety. Suppose the machine were to lose headway and fall vertically. The area resisting the descent consists of the superposed aeroplane surfaces and the horizontal surface of the balloon, which are about 1,500 and 900 respectively. The most favorable possible calculation would give a speed of descent of 20 feet per second, hardly a *safe* velocity at which to strike the earth.

Instead of taking the horse-power the same in the above example, we could have assumed equal speeds for the two machines and increased the power to suit; but the results in the latter case are equally significant and still less effective in producing safety.

The scheme of making the balloon bag itself in the form of an aeroplane seems still less promising. If the balloon were distorted enough to give it any efficiency as an aeroplane surface its weight and resistance would be prohibitive. I shall touch on this a little more fully in the paper on double balloons.

It *might* be possible to provide a regular dirigible with enough aeroplane surface to carry it safely to earth in case of an explosion; but there is no need for it. Such an accident very seldom occurs, and it is easily prevented by taking proper precautions. Such a large surface would be very heavy, and offer much resistance even when folded up. Then consider, for example, the difficulty of constructing and managing a set of aeroplanes big enough to carry a large dirigible, which would be suddenly called upon in an emergency to support 15 to 20 tons. Such an accident is much better taken care of by prevention in the first place. As a last resort, I would suggest individual parachutes for the passengers.

Changes in the Patent Office Rules

ACTING with the approval of the Secretary of the Interior, the following changes are made in the Rules of Practice in the Patent Office to take effect May 13th, 1914:

Rule 101 is amended to read:

101. Upon the institution and declaration of the interference, as provided in Rule 102, the examiner of interferences will take jurisdiction of the same, which will then become a contested case; but the law examiner will determine the motions mentioned in Rule 122, as therein provided.

Rule 109 is canceled and the following substituted in its place:

109. An applicant involved in an interference may, at any time within thirty days after the preliminary statements (referred to in Rule 110) of the parties have been received and approved, on motion duly made, as provided by Rule 153, file an amendment to this application containing any claims which, in his opinion, should be made the basis of interference between himself and any of the other parties. Such motion must be accompanied by the proposed amendment, and when in proper form will be transmitted by the examiner of interferences to the law examiner for his determination. On the admission of such amendment, and the adoption of the claims by the other parties within a time specified by the law examiner, the primary examiner will re-declare the interference, or will declare such other interferences as may be necessary to include the said claims. New preliminary statements will be received as to the added claims, but motions for dissolution will not be transmitted in regard thereto where the questions raised could have been disposed of in connection with the admission of the claims. Amendments to the specification will not be received during the pendency of the interference, without the consent of the Commissioner, except as provided herein, and in Rules 106 and 107.

Rule 122 is amended to read:

122. Motions to dissolve an interference (1) upon the ground that there has been such informality in declaring the same as will preclude a proper determination of the question of priority of invention, or (2) which deny the patentability of an applicant's claim, or (3) which deny his right to make the claim, or (4) which allege that counts of the issue have different meanings in the cases of different parties, should contain a full statement of the grounds relied upon, and should, if possible, be made not later than the thirtieth day after the statements of the parties have been received and approved. Such motions, and all motions of a similar character, should be accompanied by a motion to transmit the same to the law examiner, and such motion to transmit should be noticed for hearing upon a day certain before the examiner of interferences. When in proper form the motion presented will be transmitted by the examiner of interferences, with the files and papers, to the law examiner for his determination, who will thereupon fix a day certain when the said motion will be heard before him upon the merits, and give notice thereof to all the parties. If a stay of proceedings is desired, a motion therefor should accompany the motion for transmission.

When the motion has been decided by the law examiner the files and papers, with his decision, will be sent at once to the docket clerk.

Motions to shift the burden of proof should be made before, and will be determined by, the examiner of interferences. No appeal from the decision on such motions will be entertained, but the matter may be reviewed on appeal from the final decision upon the question of priority of invention.

Rule 124 becomes:

124. Where, on motion for dissolution, the law examiner renders an adverse decision upon the merits of a party's case, as when he holds that the issue is not patentable or that a party has no right to make a claim, or that the counts of the issue have different meanings in the cases of different parties, he shall fix a limit of appeal not less than twenty days from the date of his decision. Appeal lies to the Examiners-in-Chief in the first instance and will be heard *inter partes*. If the appeal is not taken within the time fixed, it will not be entertained, except by permission of the Commissioner.

No appeal will be permitted from a decision rendered upon motion for dissolution affirming the patentability of a claim, or the applicant's right to make the same, or the identity of meaning of counts in the cases of different parties.

Appeals may be taken directly to the Commissioner, except in the cases provided for in the preceding portions of this rule, from decisions on such motions as, in his judgment, should be appealable.

Rule 128 is canceled and the following substituted in lieu thereof:

128. *If, during the pendency of an interference, a reference* be found, the primary examiner shall call the attention of the law examiner thereto, and the latter may request the suspension of the interference until the final determination of the pertinency and effect of the reference, and the interference shall then be dissolved or continued as the result of such determination. The consideration of such reference shall be *inter partes* and before the law examiner.

Looping the Loop

A Pilot's and a Passenger's Impressions

LOUIS NOEL'S impressions of "looping the loop" in a flying machine are thus recorded in *Flight*: "There are no words in which to express the sensation. As it is, the ordinary flight is quite exhilarating, but this new stunt quite exceeds everything in the world; in fact, in a word it is super-human. When once you have done it you feel you must repeat it again and again; you are so intoxicated with the wonderful sensation. You start off, and rise to a height of between 600 feet and 700 feet, and then you can begin the joke absolutely without danger After executing a gentle *vol piqué* you pull the lever back, and the 'bus leaps with tremendous speed upward—which it loses at the zenith of the loop. At this moment you are completely isolated from the earth and you can see nothing but the planes. Then it is that an incomprehensible sensation runs through you at being absolutely alone, suspended by an invisible string amid air. I assure you it is a unique position; nothing to fear—only happiness. All this of course (unfortunately) is done and finished in a second or so, and, after diving again, you have the first glimpse of the earth under you and you can only regret that the looping is over There is just one thing to consider, however; I think that if I 'loop' often I shall lose that wonderful feeling."

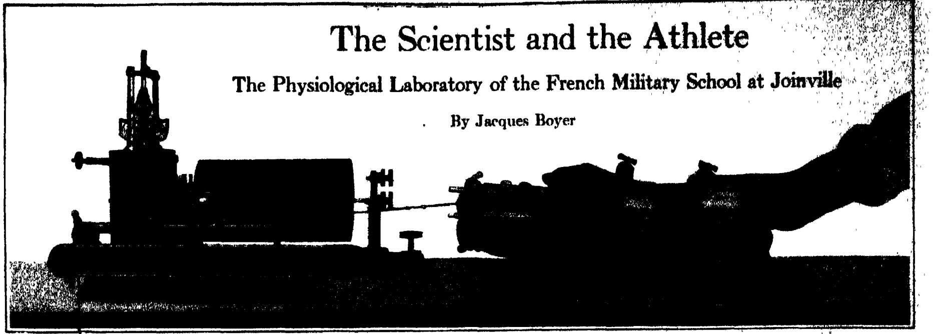
A passenger whom Noel took up in an 80 horse-power Le Rhone-Morane-Saulnier machine says in the same issue of *Flight*:

"My own impressions of looping are much the same as Noel's, but there is one point that has struck me particularly, and that is the fact that I could not realize that I was upside down. I did not feel any tendency to fall out, and if I had shut my eyes I would not have known, for the greater part of the time, that we were not flying normally. Before I ascended I took the precaution of seeing that what little coin of the realm I had in my pocket would not fall out when in an inverted position, but, as I found later, quite unnecessarily, for, once in a way, my money remained quite securely in my pocket. As far as I can put it in words, my sensations from start to finish were as follows: After climbing to a height of about 600 feet, Noel turned and inquired if I was ready, and then we dived slightly, the feeling in this case being similar to that during a *vol plané;* the ground stretched out before us, then suddenly 'rolled' out of sight as the nose of the machine was turned upward, and there was nothing but the clouded sky all round. The rush of wind, which had been intense, then seemed to die out altogether for a second or so, and now one felt that wonderful feeling Noel spoke of, of being absolutely alone and extraordinarily happy. The next sensation was exceptionally weird, for suddenly there was a terrific rush of air and the earth came into view from behind and above, and passed with startling rapidity in front of the machine, just as if some one had thrown a roll of green cloth over one's head from behind, so that it unrolled as it went. As the ground passed from overhead to the front of the machine, the sky again came into view overhead, coming up from behind as did the earth, and I realized then that we were diving and that we had been upside down All this time I felt absolutely comfortable in my seat, and it was only when we were recovering our normal position that I felt any rough movement. Each time we made the loop we came out of the top of it slightly sideways, so that when the horizon line appeared above our heads it was not absolutely horizontal. As I said before, although I saw, for the space of two or three seconds, the ground stretched out above my head, I had no feeling of being upside down."

The Scientist and the Athlete

The Physiological Laboratory of the French Military School at Joinville

By Jacques Boyer



The Mosso ergograph, which registers the work done by the fingers.

AT the normal fencing and gymnastic school which the French war ministry maintains at Joinville, systematic physical training is given to officers and men, and methods of improving the physical condition of the men of the auxiliary service are investigated. Especial attention is given to perfecting the exercises and methods of training, with the aid of scientific researches carried on in the physiological laboratory of the school.

In addition to the counting and recording instruments which are commonly employed by physiologists and psychologists for the study of respiration, circulation, and muscular contraction, the laboratory contains several novel and interesting instruments invented by Prof. G. Demeny for the determination of the form and dimensions of the body at rest and in movement. The laboratory is also well equipped for work in photography, including chrono-photography and kinematography.

The dimensions of the thoracic cavity are measured with calipers having blunt tips of ivory. One of these tips is affixed directly to one leg of the instrument, but the other tip is attached to a rod which can move in a graduated slide against the pressure of a spring. This construction allows the calipers to be withdrawn without opening them or wounding the subject. When the instrument is applied to the chest the spring tip remains in contact with the body without interfering with respiration, so that the travel of the rod measures the augmentation of the thoracic diameter in the act of inspiration. By connecting the rod with a pair of Marey capsules, a continuous record of the variations in diameter can be inscribed on a rotating cylinder.

In order to obtain more precise measurements of all dimensions of the body, Prof. Demeny has devised an instrument, the double universal conformator, which can be adjusted to trace on paper outlines of the median vertical section of the trunk, and of horizontal sections at various heights. The essential organ of this apparatus is a metal rod, to which numerous thin strips of wood, forming a continuous series, are attached transversely in such a manner that each strip can move independently in a direction parallel to its length (or at right angles to the rod) and that all the strips can be fixed in position by turning a nut at the end of the rod. The ends of all the wooden strips are brought into contact with the body, and the nut is screwed down. The contour of the body can be traced on paper from the profile of the strips thus immobilized.

With two such rods, mounted parallel to each other on suitable supports, the form of horizontal sections of the body, or of its lateral or anterior and posterior vertical profiles can be determined very quickly. Complete horizontal sections of the chest at various levels are obtained by attaching four rods to a rectangular frame, inside which the man stands on a platform which can be raised to any desired height.

The Demeny conformator reveals immediately and without calculation any defect of symmetry, such as unequal height of shoulders or hips, abnormal curvature of the spine, etc.

For the special study of the spine an instrument called a sachigraph or profilograph has been devised. Four rods, connected by movable joints to form a rhomb, are supported by a carriage that moves in a slot in a vertical post. The subject stands with his back to the post, and the carriage is moved upward, while a blunt point attached to one vertex of the rhomb is pressed against his spine. Simultaneously, a pencil attached to the opposite vertex of the rhomb traces the profile of the spine, in its true dimensions, on a sheet of paper.

Vertical sections are obtained also by an instrument which traces the profile on paper by means of pencils attached to two rods, mounted on rollers, between which the subject is placed, and which measure the thickness of the body at every point as they move up or down.

The volume of air introduced into the lungs by a deep inspiration is measured by a very simple spirometer. The inhaled air is expelled through a rubber tube into a cylindrical bell-glass, which dips into water contained in a larger glass vessel. The cross-section of the tube is made equal to that of the trachea in order to minimize resistance and disturbance of the rhythm of respiration. The bell-glass is suspended by a cord which passes over two pulleys and has a counterpoise attached to its other end. The bell-glass rises as the air is blown into it, and if its wall were infinitely thin its rise, indicated by the emergence of an attached scale from the water, would be exactly proportional to the volume of air introduced, the pressure remaining constant. In practice, however, there is a small increase of pressure, which is measured by a manometer inside the bell-glass and is applied as a correction. The spirometer is calibrated by injecting air in measured quantities, one liter at a time, and reading both the water level scale and the manometer after each addition.

Many of the physiological researches that are conducted in this military school are executed by Marey's method, which is capable of furnishing graphic records of respiratory movements, the pulsations of the heart and the arteries, muscular contractions, the pressure of the feet on the ground in walking, leaping, etc. The part of the body which is being examined is brought into contact with the flexible membrane of a Marey capsule, which is connected by a rubber tube to a similar capsule, whose membrane carries a stylus that presses on a cylinder covered with blackened paper and turned uniformly by clockwork.

The variations of muscular effort are registered by the well-known ergograph of Mosso.

The mechanism of bodily movements is studied also by means of photography, kinematography, and, especially, chrono-photography. The kinematographic analysis of movements enables the physical instructor to discover the physiological consequences of various exercises, and to classify the latter according to their effects, but he must control his deductions by attentive observation of the movements.

Chrono-photography may be defined as the photographic reproduction of successive positions of a moving object on a single fixed plate. Graphic chrono-photography is based on the same principle, but it furnishes a much larger number of images in a given time. The pictures of this sort that are produced at the Joinville school are exceedingly interesting, and convey very valuable information in regard to walking, high and broad jumping, and other exercises. So, at Joinville, physiologists and trainers work together for the improvement of physical education.

The Anti-trust Bills and the Patentee

PATENTEES have concerned themselves but little with the proposed anti-trust legislation which will soon be presented to Congress in the form of what is known as the Clayton Bill; yet that measure contains provisions which will profoundly affect the marketing of patented inventions and which will certainly be objected to by inventors and by manufacturers of patented articles.

Every invention, great or small, means a revolution in its way—a revolution in the way of shaving your face, if the invention be a safety razor; a revolution in house-cleaning, if the invention be a vacuum cleaner; a revolution in communication, if the invention be a duplicating machine, such as a mimeograph; and a revolution in transportation, if the invention should be an airship or a locomotive. Revolutions are not popular, particularly when they mean a change in personal habits. When one reads of the trials and tribulations of inventors, big and little, it is immediately driven home that the great conservative mass of humanity receives new ideas about as cordially as a Czar receives nihilist bombs. The new invention must be introduced very gradually; the general public must be educated to its use artfully by newspaper propaganda, public demonstrations, and much advertising. Difficult as it is to market staple products, the task of inducing the public to take an interest in a new invention is far greater.

If the Clayton Bill becomes a law—and it seems certain that some form of anti-trust legislation will be enacted before Congress adjourns—inventors will find their progress still further impeded by formidable legal obstacles. The revised Clayton Bill provides that anyone who shall lease or sell in the United States, "goods, wares, merchandise, machinery, supplies, or other commodities, or fix a price charged therefor, or discount from or rebate upon such price, on the condition or understanding that the lessee or purchaser thereof shall not use or deal in the goods, wares, merchandise, machinery supplies, or other commodities of a competitor," shall be liable to a fine of $5,000, and to imprisonment of one year. It has been the practice among patentees to divide the market into territories, and to give enterprising retailers in each territory license for that territory, it being usually stipulated by the retailer either that he shall have an exclusive license for that territory or that a similar competing article is to be sold to any other retailer in the same territory at higher prices or on less favorable terms. Without some such arrangement the retailer's competitors will all reap the fruits of his sowing, and will compete with him for the market which his own efforts have alone created. To meet this entirely fair demand of the retailer, which the bill does not seem to condemn, the manufacturer, in turn, is entitled to fair protection. Since the patentee must depend upon the retailer to create the demand for the article against the competition of rival brands, and since the manufacturer must assure the retailer, for a specified period at least, extra reward for the retailer's extra efforts in pushing the article, it seems no more than fair that the retailer shall give the patentee substantial assurance that he will exert more than ordinary effort in selling the article. So long as the retailer carries in stock a rival invention or offers both inventions to his trade, the retailer cannot push either against the other. Indeed, by offering both inventions alongside each other in the same store, the retailer actually increases the live weight of rival competition against which the manufacturer is struggling in his efforts to get a foothold in the territory. The very least that the manufacturer can ask, therefore, is that for a specified period the retailer shall concentrate his effort upon the manufacturer's own invention. Without such assurance from the retailer the manufacturer cannot in turn give any assurance to the retailer of extra reward for extra effort; and unless the manufacturer can give such assurance he cannot hope to find a market for his invention in territory already occupied by his rivals.

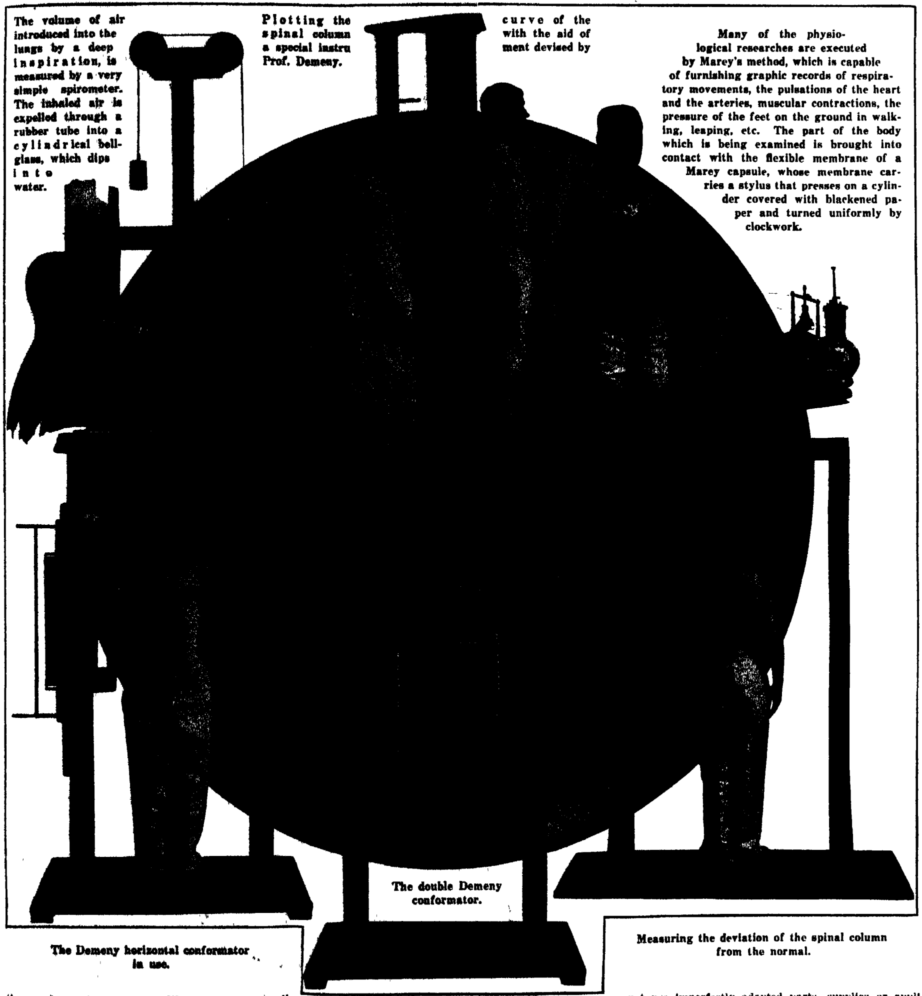
The Clayton Bill forbids the manufacturer and retailer from making any such arrangement. Any manufacturer or patentee engaged in interstate commerce becomes a criminal if he attempts to secure an ex-tire years' business as a condition of selling to a retailer; if he attempts to hold the retailer to an agreement to handle his patented articles exclusively; if he avails himself of the quality of his patented article to induce a retailer to "stock up" with that exclusively; or if he agrees in consideration of the retailer's agreement to handle his article exclusively that he will sell to other retailers only on less favorable terms.

The right to furnish repair parts—a very important right in marketing patented inventions—is affected by another provision of the bill. A manufacturer who sells a delicate machine whose successful operation depends upon perfectly adapted substitute parts, supplies, and supplementary appliances, agrees usually to furnish purchasers with such parts, supplies, and appliances, at a special price, upon the understanding that the imperfectly adapted parts, supplies or other appliances of other manufacturers shall not be used. It was brought out in the Dick case, for example, that the ink which purchasers of the mimeograph must obtain from the patentees costs no more than other ink, and that, being free from benzine, it will not dissolve the wax stencils. Other inks on the market, some of them perhaps cheaper than the ink supplied by the patentee, do contain benzine, with the result that the wax is dissolved, and that not more than two hundred or three hundred impressions can be obtained from a single wax stencil, with the result that the reputation of the machine suffers. It is possible to mention dozens of machines whose perfect operation depends upon the character of repair parts and supplies. Yet, under the Clayton Bill, a patentee may not protect the reputation of his machines by seeing that they are always operated under the best conditions.

Instead of agreeing to sell these perfectly adapted parts, supplies, and appliances at a special price, a patentee sometimes agrees to sell the original machine at a special price upon the understanding that the purchaser shall not use imperfectly adapted parts, supplies, or appliances of other manufacturers. This also is forbidden by the Clayton Bill.

But suppose a manufacturer sells no machine at all. Suppose that he only leases it, because he may be compelled to do so. The excavating machinery with which the Chicago Drainage Canal was built is an example in point. The machines in question cost $25,000 each, and there were probably not more than a dozen contractors in the whole United States who could afford to buy them. Realizing this, the manufacturers leased the machines under such favorable conditions that it was possible for any contractor to utilize them. As a result the Chicago Drainage Canal was dug at the unprecedented rate of 57 cents per cubic yard, instead of the usual 80 cents for rock excavation. The machines in question were leased on condition that certain supplies necessary for the perfect operation of the machines were to be obtained from the manufacturer. All this is forbidden by the Clayton Bill. Nor may the patentee seek to overcome the restriction by leasing the machines at a special rental upon the understanding that the lessees shall not use imperfectly adapted parts, supplies, or appliances of other manufacturers; nor may he agree to sell to the lessee perfectly adapted parts, supplies, or appliances upon the understanding that the lessee shall not use imperfectly adapted parts, supplies or appliances of other manufacturers.

Where is the stimulus to spend hundreds of thousands of dollars in devising new labor-saving machinery if this bill becomes a law? How will it be possible for a poor inventor with a good idea to interest a capitalist in his patent, if the capitalist finds it utterly impossible to market the invention in the most efficient way? Why must a man pay a fine of $5,000 and be subjected to a year's imprisonment like a common criminal because he follows business practices which good morals and honorable business conduct have sanctioned from time immemorial?



The volume of air introduced into the lungs by a deep inspiration, is measured by a very simple spirometer. The inhaled air is expelled through a rubber tube into a cylindrical bell-glass, which dips into water.

Plotting the curve of the spinal column with the aid of a special instrument devised by Prof. Demeny.

Many of the physiological researches are executed by Marey's method, which is capable of furnishing graphic records of respiratory movements, the pulsations of the heart and the arteries, muscular contractions, the pressure of the feet on the ground in walking, leaping, etc. The part of the body which is being examined is brought into contact with the flexible membrane of a Marey capsule, whose membrane carries a stylus that presses on a cylinder covered with blackened paper and turned uniformly by clockwork.

The double Demeny conformator.

The Demeny horizontal conformator in use.

Measuring the deviation of the spinal column from the normal.

The Vertical Distribution of Animals

THE accompanying drawing, reproduced from the *Illustrated London News*, shows the vertical distribution of animals in the five continents. The distance between the horizontal broken lines represents 3,000 feet. The highest point at which any animal occurs is shown by a black solid line beside the animal. The altitudinal range of the animals may extend in many cases as far down as sea level, and no animal is confined to the altitude at which it is drawn, but will extend some thousand feet lower than where actually placed.

The chief factors in the distribution of animals are suitable climate or temperature, and a suitable food supply. The food supply is obviously correlated with the temperature. In general, it may be said that the vertical or altitudinal distribution of life corresponds closely with the latitudinal or its distribution north and south of the equator. At high altitudes the temperature is cold, and we frequently find there the same type of animal that occurs at sea level in Arctic regions. Thus, essentially the same type of hare at 12,000 feet in the Alps will be found at sea level in northern Norway and Sweden. The llama, occurring at over 15,000 feet in the tropical Andes, is found at sea level in Patagonia.

The upper limit of animal life virtually corresponds with the lower limit of perpetual snow, and animals are much more abundant at lower levels, because of increased warmth and food supply. The upper part of the picture (Alps, Caucasus) represents Europe, all in the temperate zone, and shows the lower level of perpetual snow between 12,000 and 15,000 feet; while the lower portion of the picture shows the snow line at over 18,000 feet, due to the continents of Asia, Africa, and the two Americas lying partly in the torrid zone. Note that the chamois of the Caucasus is found at a slightly higher altitude than the chamois of the somewhat more northerly Alps. In Europe the woodcock is found as high as 7,500 feet, but in Asia it ranges up to 18,000 feet.

The most conspicuous mammal found at greatest height is the yak of Central Asia, attaining 19,000 feet and never occurring lower than 10,000. This is much exceeded in actual height by American vultures at 24,000. These, however, do not dwell at that altitude, but only attain it at times in their flight, obtaining their food and rearing their young at lower levels. Reptiles occur at relatively low levels, as shown by the viper (Caucasus, 8,000 feet). Insects for the most part prefer lower levels and warm climates, but may occur at high altitudes (spiders, beetles; Alps, 16,000 feet).

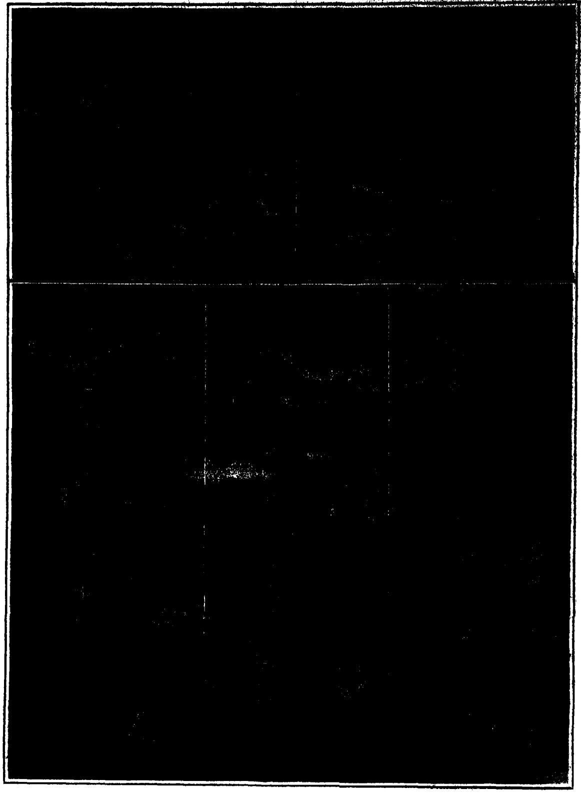
The extensive altitudinal range of certain animals or groups of animals is well shown in the section across South and North America; humming birds, from over 16,000 feet to sea level; armadillos, from 18,000 feet in the Andes to sea level in Brazil; deer, from 15,000 feet in tropical America to sea level in temperate and Arctic portions; bears, from the spectacled bear at nearly 16,000 feet in Ecuador and the true bears from 9,000 feet to sea level in temperate North America to the polar bear of the Arctic, never found more than a few feet above the ice of the ocean.

The high altitude attained by some animals is quite surprising. Note the African elephant at nearly 15,000 feet against the Indian elephant at scarcely over 6,000 feet, and observe where each would come if placed at similar heights in Europe. The high altitudes of certain [illegible] inter- [illegible] and [illegible] al- [illegible] and [illegible] essentially tropical animals, as shown by the [illegible] and lemurs, all under 3,000 feet. Sloth and anteater are also tropical animals, one reaching [illegible] and the other just over [illegible] feet in the new world tropics. The lion is more tropical than the tiger, being found at about 4,500 feet, while the latter ranges over twice as high, and is found near sea level in Siberia. The tse-tse fly is also tropical, occurring no higher than 4,500 feet in torrid Africa, so that one could dwell in Africa at over 5,000 feet and be safe from its ravages.

The peculiar animals of the Australian region, not found anywhere else, dasyures, wombats, kangaroos, wallabys, lyre-birds, and kiwis, etc., are tropical or temperate in nature and occur at relatively low altitudes, all under 6,000 feet. There are few high mountains in the region inhabited by them.

One important fact in the altitudinal distribution of life not shown in the drawing is that on mountains, the southern slopes exposed to the sun's rays are much warmer than the northern, so that animals are found at much higher altitudes on them than on the colder northern slopes of the same mountain. Also animals have a tendency to range higher in summer than in winter in the northern hemisphere, and of course the reverse in the southern hemisphere.

A knowledge of the vertical distribution of animals in any particular portion of the world is of value to man in indicating the climate of a region, of suitable crops for cultivation in such area, and of suitable breeds of animals to rear, and also in the selection of health resorts. There are parts of tropical Asia, Africa, and America, which to all intents and purposes belong to the Arctic or to the temperate zones, depending upon the elevation, and each is occupied for the most part by an appropriate assemblage of boreal or of temperate animals and plants.



This drawing, reproduced by courtesy of the "Illustrated London News," is designed to show the vertical distribution of animal life.

It is based on a series of maps which illustrate the distribution of over seven hundred families, genera and species of existing animals, and which constitutes volume 5 of Bartholomew's Physical Atlas, published at the Edinburgh Geographical Institute by John Bartholomew & Co., under the patronage of the Royal Geographical Society. While the drawing shows the highest point at which any particular animal is to be found, it does not indicate the range of that animal. The space between each pair of dotted lines represents three thousand feet.

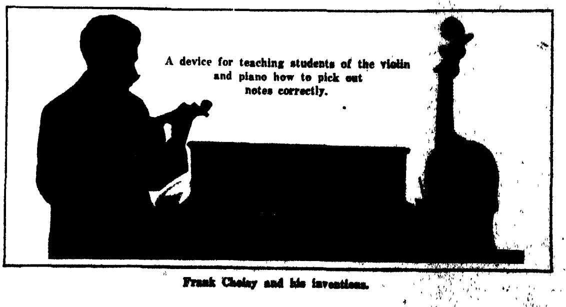
Some Helps for the Music Teacher

By Dr. Alfred Gradenwitz

IN the case of the piano, the sound corresponding to each note is invariably fixed on the instrument. Only a mistake in the key to be struck may result in grave disharmony. On the violin, and for that matter, on all string instruments, the pitch of each sound, however, depends on the position of the pupil's fingers, and since this in the beginning is practically never correct, no strictly correct sounds can be expected.

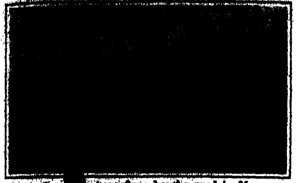
A distinguished violin teacher and composer, M. Frank Choisy of Geneva, Switzerland, has devised a simple attachment destined to obviate this drawback. The "joujusta," as this is called, is a mere sheet of paper on which the notes are inscribed

(Continued on page [illegible])



A device for teaching students of the violin and piano how to pick out notes correctly.

Frank Choisy and his inventions.



Courtesy of the Sphere. Aeroplane bombs used in Morocco.

Aeroplane Bomb in Morocco

THE Spanish army in Morocco has found the aeroplane a very effective means of coping with the guerrilla warfare of the natives. Two men in an aeroplane can sweep a wide area of difficult country and clear it of small bands or solitary snipers by dropping explosives upon them from a height above the effective range of their rifles. Needless to say, three dimensional warfare is not to the liking of the Moor. The sight of an aeroplane is in itself terrifying enough to the superstitious native. The accompanying photograph shows one of the Spanish military biplanes and the bombs that are thrown from it. By this means operations have been carried on against the Moors in regions where, hitherto, they have been safe from attack.

An Attachment for Talking Machines and Gramophones Which Improves Their Reproduction

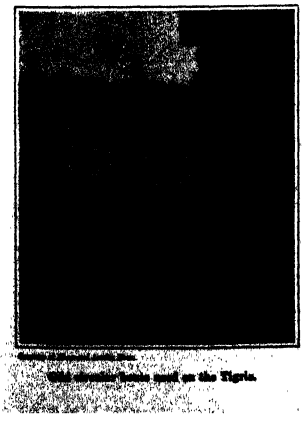
IN the SCIENTIFIC AMERICAN of September 27th, 1913, we published an article on an invention patented by Mr. M. B. Claussen for amplifying the reproductions of talking machine records, which invention consisted in inserting the steel reproducing needle through a specially formed celluloid disk. Simple as the invention is, the effect is remarkable. With a fine needle a volume of sound can be obtained which exceeds that produced by a coarse needle, with the additional result that all the delicate shades which only a fine needle can reproduce and which escape a coarse needle, are heard. Mr. Claussen has patented a modification which permits the use of the fiber needle. If anything, the effect of the celluloid disk is even more pronounced than with the steel needle. Those who use fiber needles know that they are superior to steel points because the scratching is reduced, the tone is purer, and the records are not worn away so quickly. Mr. Claussen passes the fiber needle through a ball and socket joint in the center of the disk, so the needle can be adjusted to any angle. It is now possible with this invention to use the fiber needle with those records for which it is peculiarly adapted, with the assurance that the sound to be obtained is greatly amplified and a richness of quality obtained otherwise quite impossible.

The Kufas of the Tigris

HERODOTUS, in the account of his travels, made note of the peculiar boats used on the Euphrates, as follows:

"The boats used by those who come to the city of Babylon are of a circular form, and made of skins. The ribs of the vessels are formed of willow boughs and branches. They are round like a shield, there being no distinction between the head and the stern. They line the bottoms of the boats with reeds. The boats have two oars, one man to each. One pulls to him; one pushes from him."

Very evidently that is a land of little progress; for circular boats are still to be found there, which fit exactly the specifications jotted down by the Greek historian. They are known as "kufas" and are in common use on the Tigris. The photograph shows a typical scene at Bagdad. The buoyancy and stability of the kufa is demonstrated by the boat in the foreground, which is about to land its passengers.



[illegible]

Old circular boats used on the Tigris.

Curious Life-saving Suit

A GERMAN engineer has invented a very peculiar life-saving device, which is illustrated in the accompanying engraving. It consists of a water-tight canvas suit in the shape of a bag, with sleeves for the arms and a dome-shaped top that closes over the wearer's head. The sleeves terminate in gloves, so that no water can enter the suit through them. The top is provided with a porthole, through which the wearer may take note of his surroundings. However, a slide is provided to seal the porthole hermetically. Projecting from the top of the suit is a pipe through which air is admitted. In order to keep the device upright, a metal can or bucket is fastened to the bottom of the suit. There are openings in the top of the bucket, so that it will fill with water and act as a weight. Within the suit a limited stock of provisions may be carried. Around the top hand ropes are secured, to which two or three persons may cling and keep themselves afloat. The occupant of the life-saving device can propel himself by using his arms as paddles.

By courtesy of the Sketch

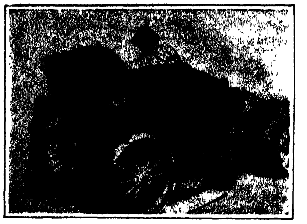
Peculiar life-saving suit.

Motor Stage Line Over a Desert

THE lapse of ten or, at the outside, not more than twenty progressive years has driven the far-famed stage coach from the highways of the West. To-day, where the railroads have not penetrated the motor stage holds undisputed sway.

There is an automobile stage running between Yuma, Ariz., and Holtville, Cal., which is truly a curiosity. Holtville lies at the eastern edge of the developed portion of the Imperial Valley. From there it is a jump of 56 miles across the desert to Yuma, Ariz. There is a railroad running from Yuma to Holtville, but it goes by a circuitous route, and costs the traveler much money and time. Accordingly, an enterprising man, George H. Johnson, undertook to establish a motor stage service. Before the loaded car had gone ten miles on its first trip, it was wallowing up to the axles in the sand of the Colorado River desert. After shoveling it out, Johnson spread long strips of canvas ahead of the machine, and in that way kept it out of the sand-holes to the end of the journey. But that was too slow a method of traveling. Service was discontinued until the problem was solved.

Johnson invented what we might call a "sand belt" to keep the machine from sinking into the sand, while it is crossing the desert. It is merely a set of threshing machine belts so arranged upon wood rollers that they travel over and under the rear wheels of the car, much in the same manner that the caterpillar engine's track rolls along beneath it when it is in motion. The belt is about a foot wide, and it runs upon a roller over each wheel, and another roller located about midway between each front and rear wheel. The belt is about half an inch thick, and it runs rather slack. It is easily attached and removed, and is substantial enough to hold the rear wheels out of the sand when it is crossing the desert with a load of passengers.



Sand belts to keep the wheels of the car from sinking into the sand.

How a Serious Accident May Be Prevented

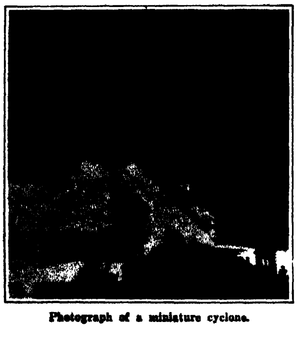
A SERIOUS accident can happen with an automobile in case the driver stops it by simply cutting the ignition and braking, without putting the speed lever at the off point, for should the motor clutch remain on, the car will start off as soon as the crank is used to set the motor running The driver thus risks being run over by his own car, or the vehicle runs wild at a high speed. An ingenious electric device can be used to make such an accident impossible, and it consists in mounting a relay so that when its magnets work, the relay contact cuts the ignition circuit. The magnet is in a battery circuit, which includes the crank, motor, and speed lever The sector of the speed lever is specially made so that all the points except the zero point make connection with the circuit, while the zero point cuts the circuit. When the lever is on point 2, for instance, current can pass through the lever part to the magnet. Suppose the lever to have been left by mistake on this point, when the driver applies the crank against the motor for starting, he closes the circuit and operates the relay, thus opening the second or ignition circuit, which as stated is worked by the relay contact. Applying the crank thus cuts the ignition and it is impossible to start the motor until the lever has been shifted to the zero point on the sector

Another Russian Gold Field

THE American consul general at Moscow reports that rich gold fields have been found in the district of Anadyr, Siberia, along the River Bielaya, consisting of a thick stratum of auriferous sand under a thin layer of peat. The difficulty of mining is great, owing to the fact that food and other necessaries cannot be procured nearer than at a distance of 200 to 300 miles

Miniature Cyclone

THE freak cloud herewith illustrated was photographed at Whittier, Cal., following a heavy rainstorm. The cloud was very active, having a rapid spiral movement, at the same time traversing the sky with the group of clouds to which it seemed attached. It remained visible for perhaps an hour, but was ultimately broken up, apparently by its own violent movement.



Photograph of a miniature cyclone.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

LIFE SAVING SUIT—CARL G. WALLS, 33 Tompkins Place, Brooklyn, N Y. This life-saving suit is designed to keep the wearer afloat in the water, while at the same time allowing convenient use of arms and legs for swimming and other purposes The suit which is waterproof and air tight is not only adapted for victims of accidents at sea, but also for hunters, fishermen and soldiers, in short for every one exposed to cold and dampness.

LIFE-SAVING SUIT.

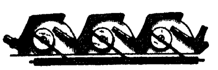
Of Interest to Farmers.

BEET-HARVESTER.—J. B. DAWSON, Box 57, Pompeys Pillar, Montana. This harvester is adapted for use with crowning mechanism previously patented by Mr. Dawson, but may be used with any other form of crowning mechanism. Means are provided for lifting the crowned beets from the soil without injury, separating them from the soil, and delivering them into a dumping container

TRIP MECHANISM FOR BUNDLE-CARRIERS.—J BAXTER, R. F D. No 3, Moscow, Idaho. To provide means for stopping the delivery of bundles or sheaves from a carrier, to provide means for manually releasing the bundles for delivery, and to simplify the mechanism for effecting these operations, are the principal objects of Mr Baxter's invention.

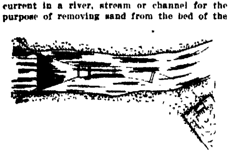
Of General Interest.

GRATING.—A. DARROCH, 369 Ninth St, Brooklyn, N Y. This inventor's object is to provide a grating for use in roofs of subways, buildings and other structures, and arranged to prevent rain water, débris and the like from passing through the grating, to illuminate the space below the grating by refracted light, to provide proper ventilation for the said space, and to close the grating in case of fire to prevent draft To accomplish this result, use is made of grate bars provided with arched roofs open at one side a building light extending under each roof below the opening thereof, and a ventilator under each roof adjacent the inner end of the said building light



GRATING FOR SUBWAYS, BUILDINGS, ETC.

SAND AND WATER CONVEYER.—C A DEAL, 4209 Walnut St., Kansas City, Mo. This improvement relates to means for utilizing the current in a river, stream or channel for the purpose of removing sand from the bed of the body of water and conveying it from a point up-stream to a point far enough down-stream to allow sufficient fall for the purpose

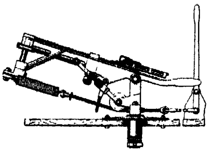


SAND AND WATER CONVEYER.

SPARK ARRESTER.—S E PHEISTER, Yacolt, Wash. This improvement relates to a spark arrester to be applied to the smoke-stack of locomotives, stationary boilers, and donkey engines and other similar engines, and arranged to permit of the free escape of the smoke, while arresting the cinders, sparks, etc.

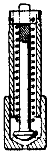
WINDOW-FITTING FOR BLINDS—F F COWDROY, 311 Miller Street, North Sydney, New South Wales, Australia. To eliminate the damaging effects of repeatedly fixing brackets to window frames for shades of different width, Mr Cowdroy has invented a fixture which may be permanently attached to the window and which has shade brackets adjustable laterally for various sizes of shades, and curtain pole brackets adjustable vertically for curtains of different lengths.

BLUE ROCK TRAP.—D. BEST, San Leandro, Cal. An object here is to provide a device having a frame which may be turned at any angle of the field, without causing extra strain, or having a tendency to pull the frame out of position. A further object of the invention is to provide a device in which the rocks are caused to spin, and in which the throwing arm is automatically brought back into position ready for another throw.



BLUE ROCK TRAP.

AUTOMATIC DRAIN VALVE—W R HUDDLESTON, Box 174, Brownsville, Tex The purpose here is to provide a valve adapted for use in connection with the main reservoir of air braking systems, for automatically draining the reservoir and the system of water wherein a normally open spring supported valve is provided, adapted to be closed by the pressure in the system, when such pressure exceeds the normal atmospheric pressure.



AUTOMATIC DRAIN VALVE

Hardware and Tools.

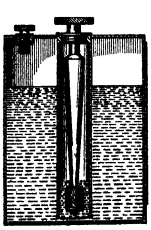
NUT LOCK.—A H. WEGENER, 1105 Garden St., Hoboken, N. J. Among the objects of the invention is to provide an automatically gripping device for locking a nut to a bolt, but which will permit the unscrewing of the nut under force applied thereto by means of a wrench or the like without seriously damaging either nut or bolt thread.

FASTENING DEVICE—M J. MYERS, care M. J Myers Co., 135 W. 26th St., New York N. Y. The inventor provides a device which may be used on clothing and other articles, and which is constructed by providing a member with a longitudinally extending slot terminating at its ends in stud openings one of which extends in the member at one side of the slot, and the other extends in the member at the other side of the slot

SNAP HOOK.—C. E. KELLY, Griffin Corners, N Y. With the present invention Mr Kelly provides the catch with guiding means to control the same when it is moved into and out of locking position, and he secures the spring in fixed relation to the catch, so as to make the hook more easily operable

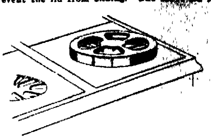
Heating and Lighting.

PORTABLE LIGHTER—G SCHLEICHER, 37 W 14th St, Manhattan, N. Y, N. Y Among the principal objects which the present invention has in view are to provide a container to hold free liquid fuel for use in delivery in regulated quantities, to avoid flooding and evaporation of the said fuel; and to prevent a variation in the delivery of the fuel from the said container In the accompanying engraving a vertical longitudinal section of the portable lighter is shown.



PORTABLE LIGHTER.

STOVE-LID.—J. BRAUBACH, 107 Fourth St., Hoboken, New Jersey. The lid is adapted to be used on gas stoves of usual construction, being provided with shoulders adjusted so at the sides of the opening in the stove top to prevent the lid from sliding. The [illegible] is provided with a centrally disposed disk with a series of holes clustered about it and a series of strengthening webs all with the purpose of diffusing under control the heat produced by the gas burner.



HEAT DIFFUSING LID FOR GAS STOVES.

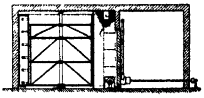
Household Utilities.

SAD-IRON.—J. W. AUSTIN, care of Central Flatiron Manufacturing Company, Binghamton, New York. This sad-iron is provided with means whereby the size of the mixing chamber for the gas and air can be enlarged or reduced at the will of the operator. The burning gas is utilized to the best advantage and all danger by back-firing is completely prevented, the usual chimney being dispensed with.

ATTACHMENT FOR COOKING UTENSILS.—C. N. SOWDEN, Guantanamo, Cuba. The invention provides a means for holding two sauce-pans or like utensils of different size, relatively spaced one within the other so as to constitute a double cooker. The attachment consists of a device which may be applied to the handles of the two utensils to hold them in the proper fixed relation to each other.

Machines and Mechanical Devices.

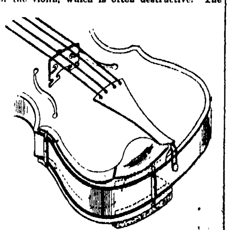
REFRIGERATING APPARATUS.—S. MACKIN, 1020 Santa Rita Ave., Laredo, Tex. The main object of the invention is to provide a means for hardening ice cream. The apparatus is provided with a series of shelves which may be revolved to bring them in position whereby the contents of the shelves may be removed or replaced. The shelves are placed in a novel form of vault and novel means for maintaining the vault in cold condition are provided



REFRIGERATING VAULT FOR HARDENING ICE CREAM

Musical Instruments.

VIOLIN CHIN REST.—C. J. EDLAVITCH, 12 Albemarle St., Baltimore, Md By the use of widely spaced clamping members, this invention avoids creating a strain at a single point of the violin, which is often destructive. The inner portion of the chin and shoulder plates are prevented from coming into contact with the surface of the instrument Such contact would destroy, in a measure, the tone of the instrument.



CHIN REST THAT AVOIDS STRAINING VIOLIN BODY.

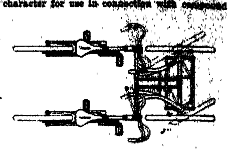
Prime Movers and Their Accessories.

MEANS FOR PROPELLING SHIPS AND THE LIKE S. GOUNOUILHOU, 8 Rue de Cheverus, Bordeaux, France. This invention has for its object a system of propulsion for ships and the like by means of wheels, and has more particularly for its object to direct the fluid jets projected by the wheels in such a manner as to bring them into a horizontal direction and utilize their *vis viva* for the propulsion.

ROTARY EXPLOSIVE-ENGINE.—J. D. BLAYNEY, Edmonton, Alberta, Canada. The apparatus consists of a series of explosive engines grouped about a central driving shaft. Each engine drives a pinion meshing with a large gear upon the driving shaft, the object being to obtain greater [illegible] size and weight, and [illegible] of equal distribution of [illegible] and proper balancing of the parts.

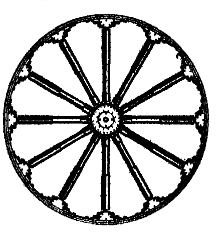
Pertaining to Vehicles.

STEERING GEAR FOR VEHICLES.—[illegible] OTTEN, 1862 Linden St., [illegible] N. Y. This invention relates to steering gears for vehicles and has particular reference to means of this character for use in connection with compound cycles or devices which are propelled by the riders or by motive power. More particularly stated the invention contemplates the employment of two bicycle constructions made or connected in parallel and with a single steering mechanism for the combined wheel.



STEERING GEAR FOR VEHICLES.

RESILIENT WHEEL.—A. T. GOOKIN, 50 Dana St., Cambridge, Mass. This improvement involves a new form of resilient wheel, and the principal purpose of the invention is to provide an improved device of this class. A further object is the provision of a wheel made up of a hub and rim with a number of resilient spokes therebetween, whereby when the wheel rolls over the ground the resiliency of the wheel will take up the shocks due to unevenness of the road.



RESILIENT WHEEL.

DOOR-LOCK.—W. J. FLEISCHAUER and H. RICHARDSON, 10 Edison St., Pontiac, Michigan. The invention provides an improved lock of the type particularly adapted for use on automobile doors. It consists of a strong and durable construction embodying a minimum number of parts so co-operating as to prevent the door from rattling when closed.

WATER, LAND, AND AIR MACHINE.—E. E. GREGORY, Central City, Ky. The invention provides a hydro-aeroplane adapted to run on land. Hence, this vehicle may be used as an aeroplane, as a boat or as a land vehicle, without any change in device when going from one element to the other. The vehicle is provided with a novel form of hull for use on the water which serves as a main sustaining plane when used in the air.

Designs.

PAPER BELL.—B. KARFIOL, care of Royal Wastepaper Works, 842 Lorimer St., Brooklyn, N. Y. The bell is of the folding paper type, and has parallel horizontal stripes of various solid colors extending through it.

WEDDING RING—M. ROSEN, 1167 Vyse Avenue, New York. A distinctive characteristic of this design is that annular spaces of even width extend about the ring to show both at the outer and inner surfaces thereof.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

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"SIXES" RUN 32.8 MILES ON ONE GALLON OF GASOLINE

NINETY-FOUR CARS MAKE STARTLING AVERAGE IN "FRANKLIN" TEST

"Stock" Machines With Three Passengers Each Make Simultaneous Record Runs in All Parts of United States

VICTORY FOR LIGHT-WEIGHT IDEA

Many Dealers, Sold Out, Compelled to Borrow the Machines of Local Owners to Take Part. Varying Weather Conditions Met.

Syracuse, N. Y.—On May 1st, 94 Franklin dealers in the United States and Canada, in 94 Franklin Six-Thirty stock touring cars, regardless of weather conditions, made a test to demonstrate the best possible mileage on 1 gallon of gasoline.

The rules required that the finish be as near the starting point as possible. Each test was made with two official observers, and results sworn to before a Notary Public. The test represents the average of 94 cars, 94 drivers, various road conditions, all kinds of weather, different grades of gasoline and, therefore, what can be obtained by skillful driving in the scientifically light-weight six-cylinder Franklin car.

The highest mileage, 51.2 miles, was made by Wm. F. Sanger, Milwaukee, Wis.

The different conditions under which the tests were made are graphically shown by the following telegrams:

Salt Lake City, Utah—"40.1 miles. High wind and wet roads or could easily have made 50."

Laramie, Wyo.—"32.1 miles. Weather cold. Roads rough but hard."

San Diego, Cal.—"33.1 miles. Roads very slippery. Drizzling rain during run. Rather cold. Conniry drove. Top and glass front down. H. C. Covell, Club Representative; Louis Elmgren, Fire Chief; observers. Car with load weighed 3385."

Georgetown, Texas—"Made 17.2 miles. Top and windshield up. Wet and badly washed pike roads. Very little wind. Three passengers and car weighed 3310 including accumulated mud. Showered just before starting. Average speed eighteen miles per hour. Affidavit follows by letter."

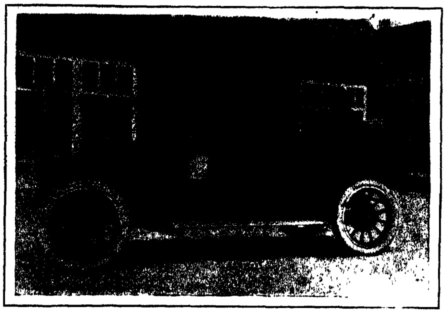
Bangor, Maine—"21.5 miles. Dry dirt roads, rough in places, and hilly. Weather cold, thermometer 31 at six, 45 at end of run. Strong wind. Driver Hall. Weight 3250. Glass front and top down. Snowed lightly during night. Started at ten, finished at eleven-thirty."

Newark, N. J.—"On official test obtained 34-4/10 miles. Roads dry, fair condition. Weather clear, mild. Driver Walter Parcells. Weight of car including passengers 3320 pounds. We doubled back over identical course. Course contained 15 hills (grades from 2 to 8 or 10 per cent). Demonstrating car used, run total 5,000 miles covered period 6 months."

York, Pa.—"Made thirty-seven and nine-tenths miles on turnpike which was covered one tenth of way by deep blue stone. Can do forty-five miles if roads are in good condition."

Kansas City, Mo.—"Williams makes forty-two and eighty-eight hundredths miles on one gallon gasoline. Weather cool. Slight wind. Roads good."

(Continued in booklet, sent free on request by Franklin Automobile Company, Syracuse, N. Y.)

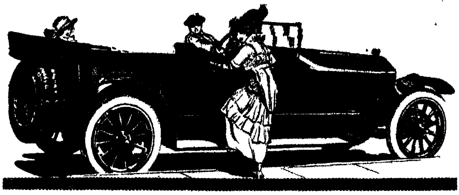


THE MILWAUKEE TEST CAR JUST IN—51.2 MILES ON ONE GALLON

THE CERTIFIED INDIVIDUAL RECORDS

City	*Dealer*	*Weather*	*Record*
Milwaukee, Wis.	Wm. F. Sanger	Fair	51 2
Aberdeen, S. D	G. M Worthington	Fair	18 3
Akron, O.	A Auble, Jr.	Windy	30 3
Albany, N. Y.	C. G. Heck	Windy	33 1
Auburn, N. Y.	George H. Leonard	Windy	36 6
Baltimore, Md.	W. F. Kneip	Windy	36 0
Bangor, Me.	Edwin O Hall	Windy	21 5
Bar Harbor, Me.	Fred L. Savage	Fair	36 1
Binghamton, N. Y.	S H. Lewis	Fair	32 8
Boston, Mass.	Otto A Lawton	Fair	49 5
Bridgeport, Conn	Arthur L. Clark	Windy	34 4
Buffalo, N. Y.	George Ostendorf	Windy	27 7
Canton, Ohio	Geo. W Belden	Fair	29 9
Charlotte, N. C	J. B Woodside	Windy	26 0
Chicago, Ill.	F. H Sanders	Fair	31 3
Cincinnati, O	Newman Samuel	Fair	37 3
Colorado Springs, Colo.	G. W. Blake	Rain	30 0
Cumberland, Md.	A E. Glisan	Fair	50 9
Dallas, Tex	W G Langley	Windy	29 9
Dayton, Ohio	F B. Heathman	Fair	33 2
Denver, Colo.	F C Cullen	Rain	26 3
Duluth, Minn	D. Peacha, Jr	Windy	32 7
Eau Claire, Wis.	G. R. Wood	Fair	33 7
Edmonton, Alta.	Holland W Ross	Fair	30 3
Elizabeth, N. J	F. V. Price, Jr	Windy	41 2
Erie, Pa	John Griffith	Windy	30 5
Galesburg, Ill	E. T. Byram	Fair	20 2
Geneva, N. Y.	W W McCarroll	Fair	35 7
Georgetown, Tex.	T. J. Caswell	Rain	17 2
Grand Rapids, Mich.	John Vlasblom	Fair	22 5
Great Falls, Mont.	B. D. Whitten	Fair	31 4
Greensburg, Pa	E. L. Turner	Fair	25 7
Hagerstown, Md.	H. E. Baker	Fair	25 2
Hartford, Conn	H. P. Seymour	Windy	33 5
Hoosick, N. Y.	John Moseley	Fair	36 5
Hutchinson, Kans.	L. B. Young	Fair	25 0
Kansas City, Mo	E. F. Williams	Cool	42 9
Kingston, N. Y	William M. Davis	Windy	31 7
LaCrosse, Wis	Alfred James	Fair	25 0
Laramie, Wyo.	E. Lovejoy	Fair	32 1
Little Rock, Ark	J F. Jones	Fair	34 1
Los Angeles, Cal.	R. C. Hamlin	Rain	34 8
Louisville, Ky	George M Younger	Fair	35 1
Minneapolis, Minn.	L. A. McKay	Windy	42 8
Newark, N. J.	W. L. Mallon	Fair	34 4
Newburgh, N. Y.	George Mason	Fair	33 9
New Haven, Conn.	Cowles Tolman	Fair	45 5
New York City	G A Tisdale	Windy	39 4
Norwich, N Y	A M Jones	Windy	30 0
Oakland, Cal	Frank Bartels	Windy	31 5
Paterson, N. J	J S Hughes	Fair	25 1
Pendleton, Ore	J W McCormmach	Fair	33 8
Peoria, Ill.	S. K Hatfield	Fair	32 2
Philadelphia, Pa.	James Sweeten, Jr	Windy	33 3
Phoenix, Ariz	George Hageman	Rain	28 6
Pittsburg, Pa.	W. Murray Carr	Fair	30 5
Portland, Me	W M Chellis	Fair	36 2
Portland, Ore.	J. C. Braly	Fair	30 1
Poughkeepsie, N Y.	William M Davis	Windy	31.6
Providence, R I	Wallace L Wilcox	Windy	34 4
Putnam, Conn.	O C. Bosworth	Windy	33 3
Reading, Pa.	James M Kalbach	Fair	27 8
Rising Sun, Ohio	E. F Day	Windy	24 0
Rochester, N Y	G R MacCollum	Windy	34 8
St. Louis, Mo	Jos B Dryer	Fair	37 9
St Paul, Minn	A H Clark	Fair	32 5
Salt Lake City, Utah	J F Langford	Wet	40 1
San Angelo, Tex	M C. Ragsdale	Rain	26 3
San Antonio, Tex	I F Birdsong	Rain	20 8
San Diego, Cal.	Wilson S Smith	Rain	33 1
San Jose, Cal	L Normandin	Fair	34 9
San Francisco, Cal.	John F McLain	Windy	36 1
Scranton, Pa.	O. D DeWitt	Fair	31 7
Seattle, Wash.	W A. Wicks	Fair	43 0
Sheboygan, Wis.	N P Hanson	Windy	28 6
Shreveport, La	W H. Johnson	Fair	23 7
Sioux City Ia	Thomas Murphy	Fair	39 6
Sioux Falls, S. D	Knapp Brown	Fair	28 1
Spokane, Wash	J A. Nichols, Jr	Windy	42 5
Springfield, Mass	W. W Anderson	Fair	36 8
Syracuse, N Y.	T A. Young	Windy	40 3
Tulsa, Okla	W P. Chapple	Fair	24 8
Uniontown, Pa	C W. Johnson	Windy	18 9
Utica, N. Y	W. W. Gerabrant	Windy	30 4
Victoria, B. C.	G H. Grant	Fair	32 0
Walla Walla, Wash	R. H. Tuttle	Windy	34 0
Washington, D C.	David S. Hendrick	Windy	32 4
Washington, Ia.	Sidney S. Smith	Fair	26 2
Waterloo, Ia.	R. H Cramer	Wet	25 1
Wilkes-Barre, Pa.	William S. Lee	Windy	31 5
Winnipeg, Man.	James B. Stephens	Fair	38 0
Worcester, Mass.	V. J. Eckberg	Windy	34 3
York, Pa.	T S Pfeiffer	Windy	37 9
Youngstown, Ohio	J. Stuhldreher	Windy	36 4
AVERAGE			**32.8**

FRANKLIN SIX-THIRTY, 2725 POUNDS, 4½ INCH TIRES



National

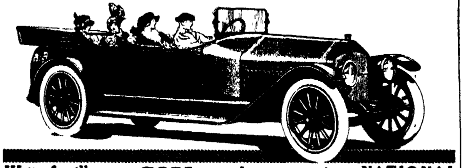
Beauty, Luxury and Utility That Reflect Good Taste and Judgment

The smart, sloping hood and pointed effect of the *National* (due to the body converging towards the radiator) adds a distinct note of attractiveness. The wide metal guards are enclosed, continuous and unobstructed. These points of refinement and care help give the *National* its *ensemble effect* of a long, low, graceful craft.

The admitted mechanical superiority of the *National*, added to its comfort and convenience, gives you the ideal combination of a quality car, built and guaranteed by an old, reliable and successful institution. The rear springs on the new "SIX" are of the Cantilever type. The left side drive, center control, convenient and simple dash equipment and easy access to all four doors add to your comfort and satisfaction.

National cars are built for service, proved by their fourteen years of dependability and reliable performance; their ample reserve force and speed when you need it, or two miles an hour if you prefer.

We say "you don't have to raise the hood" because the *National's* success justifies your confidence in our mechanical ability.



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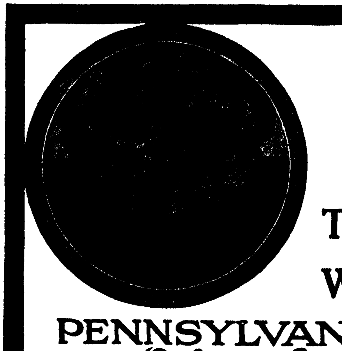
SIX—$2375
FULLY EQUIPPED

NATIONAL MOTOR VEHICLE CO.
INDIANAPOLIS, IND.



If All Tires Were

PENNSYLVANIA
Oilproof
VACUUM CUP TIRES

Skidding on slippery pavements—the greatest single cause of automobile accidents—would be unknown.

V. C. tires have been guaranteed for many years not to skid on wet or greasy pavements, else returnable at purchase price. Never a claim from a user.

Tire trouble and expense—the greatest drawbacks to the use of automobiles—would be so normal and nominal as to constitute the least of all automobile service complaints.

V. C. tires are guaranteed for a low minimum of 4,500 actual miles and maintain an average nearer twice that distance.

The oiled road would be a *complete* comfort—not to be avoided but enjoyed.

V. C. tires are guaranteed absolutely immune to the rubber destroying effects of oil.

Every year adds enormously to the number of those who know Vacuum Cup Tires as the ONLY tires for utmost safety and service. 1914 has already broken previous yearly records.

Sold Everywhere

Pennsylvania Rubber Co., Jeannette, Pa.

New York, Chicago, Cleveland, Boston, Pittsburgh, San Francisco, Los Angeles, Detroit, St. Paul, Minneapolis, Omaha, Kansas City, Mo., Seattle, Dallas, Atlanta

An Independent Company with an independent selling policy

Training Marksmen by the Kinetomatograph

(Concluded from page [illegible].)

light was shining, becomes shifted a quarter of an inch, and is thus obliterated, the screen presenting an opaque surface to the firing line once more. By moving the back or third sheet at intervals in a horizontal direction the possibility of a series of holes—one in each sheet—coming into line and indicating a false hit is rendered extremely remote.

When the rollers have become exhausted of paper it is only necessary to change them, thereby permitting the paper to be used again. As a rule the picture is kept stationary upon the screen for about two seconds, which is quite adequate for determining the effect of the shot.

The pictures are projected at the normal speed—16 per second—and at first sight it may be thought that the almost brutal instantaneous starting and stopping of the projector mechanism would injure the film. But such is not the case. The wear and tear upon the celluloid ribbon is no more severe than when it is run through the lantern in the usual manner.

Holding the picture stationary in the gate under full illumination, however, presented one difficulty. As a rule, if a film is arrested and held for only a fraction of a second it will ignite, owing to the intensely concentrated heat brought to bear upon it. Although ordinary films are used in this apparatus there is no risk of firing. A radiator is built around the condenser, which acts as a cooling tank, and this keeps the celluloid film quite cool during the period of rest.

The great advantage accruing from this "life target," as it is called rather appropriately, is the way in which it fosters quick sighting and snap shooting. This is the factor which appeals especially to military experts to-day. The recruit may be somewhat slow in these elements when he faces the target for the first time, and even twelve pictures per second is somewhat too rapid movement for him, but he soon realizes the new conditions and almost mechanically adapts himself to the life-like conditions. Within a few weeks he becomes as efficient a snap-shooter and marksman as could be desired and far more so than is possible by ordinary target practice

Possibly the one objection to the system is that the range is point blank. It can be used only for short distances. The average firing distance is about 30 feet, which, with the modern service weapon, is too short to be likely of realization in actual service. This limitation arises from two sources. The first is the restricted widths in which the paper can be woven at the mill, as a big screen formed by attaching two or three widths together is impracticable, owing to the risk of light showing through immaturely prepared seams, and from mechanical difficulties attending the utilization of reels of paper say twenty feet wide. The second is an optical problem Under present conditions 300 feet represents approximately the extreme distance at which a picture thrown upon a screen may be seen clearly. Consequently, when it comes to service practice with a magazine rifle, questions of trajectory and windage do not arise. This drawback, however, is of secondary importance in one respect, since practice with the target assures that desideratum which is essential to modern military conditions—to sight and fire quickly.

Some Helps for the Music Teacher

(Concluded from page 432.)

at the place corresponding with each of them on the four strings of the instrument. This sheet, which is made in various sizes, is slipped below the strings and fastened to the handle by moistening its gummed edges. The pupil has only to put the fingers of his left hand on the black dots corresponding to the notes, in order to produce every sound with absolute purity. At the beginning of instruction, this gymnastics of the fingers should preferably be made without bow, the latter being at first put empty on the strings.

LEGAL NOTICES

PATENTS

If you have an invention which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of more than sixty years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to PATENTS, TRADE MARKS, FOREIGN PATENTS, etc.

All patents secured through us are described without cost to the patentee in the SCIENTIFIC AMERICAN.

MUNN & COMPANY
361 BROADWAY, NEW YORK
Branch Office, 625 F Street, Washington, D. C

Classified Advertisements

Advertising in this column is 75 cents a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

AGENCIES WANTED

OLD ESTABLISHED London Firm seeks agencies for Patented articles and novelties, or representation of American Firms of good standing. Rickmann Limited, Huggin Lane, Queen Victoria St., London, England.

HELP WANTED

Young men of good personality and education, possessing tact and ability for special work in connection with our Circulation Dept. To those who fill our requirements we can offer pleasant, remunerative employment either for part or the whole of their time. Apply by letter only to Circulation Dept., Scientific American, 361 Broadway, N. Y. City

POSITION WANTED

AN EXPERIENCED TEACHER of Technical English wishes a permanent position in connection with a first-class Engineering or Mining School. Excellent references. Teacher, Box 773, New York.

SCIENTIFIC APPARATUS

GLASS APPARATUS, thermometers for scientific and industrial laboratories, surgical glassware, experimental work. For further particulars address Laboratory Supply Co., 126 State St., Rochester N.Y.

SPECIAL MACHINERY

EXPERIMENTAL WORK. Special Machines. Let me build your model, develop or manufacture for you. First-class machine-shop at your service on hourly or contract basis. For particulars apply to A. H. Emery, Glenbrook, Conn.

INQUIRY COLUMN

READ THIS COLUMN CAREFULLY. You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. *In every case it is necessary to give the number of the inquiry.* Where manufacturers do not respond promptly the inquiry may be repeated.

Munn & Co., Inc.

Inquiry No. 9358.—Wanted the name and address of maker of a machine to cut and granulate leather.

Inquiry No. 9359. Wanted the name and address of a firm that makes razor blades for all makes of safety razors.

Inquiry No. 9360 Wanted the name and address of parties making pipe fittings such as ferrules, stems and bowls such as could be used in the making up of calabash pipes for smoking.

Inquiry No. 9361. Wanted to buy a Nut Cracking Machine, especially good for Pecans.

Inquiry No. 9362 Wanted the name and address of the makers of a machine for splicing ties.

Inquiry No. 9363. Wanted the names and addresses of manufacturers of machinery for printing on intaglio copper plates.

Inquiry No. 9364. Wanted the name and address of buyer of mica in a crude state.

Inquiry No. 9365. Wanted the name and address of a manufacturer of machinery for embossing tin foil as is used in packing cigarettes.

Inquiry No. 9366. Wanted the name and address of a manufacturer of wire wheels, front axles complete with steering or separate, light sheet metal bodies, fuel tanks with cocks, pressed steel frames, mufflers, motors of the two-cylinder opposed type, cushions and many smaller parts for cycle cars.

Inquiry No. 9367. Wanted the name and address of a manufacturer of an automatic [illegible] machine.

Inquiry No. 9368. Wanted, the name and address of glass-bottle manufacturers or glass blowers who can manufacture a glass bottle and perforate it with some 12 small holes, in large quantities for export, to sell at a popular price.

Inquiry No. 9369. Wanted, the names and addresses of users of Indian Steatite (Soapstone), Corundum and other Indian minerals, in quantities.

Inquiry No. 9370. Wanted the names and addresses of manufacturers of small wooden articles, particularly in such soft woods as pine and fir, for articles such as toys, furniture, etc.

Inquiry No. 9371. Information wanted where one could buy or have made to order machines to be used for making solid back brushes.

Inquiry No. 9372. Wanted the name and address of manufacturers of a collapsible box about 12 inches square. It must be strongly made to withstand rough usage in transit.

Inquiry No. 9373. Wanted the name and address of a manufacturer of machinery that will make twine out of scrap paper.

Inquiry No. 9374. Wanted the name and address of manufacturers of a powder which, when mixed with cold water, will make a white paste suitable for papering, costing no more than 3 cents per pound in ton lots.

Inquiry No. 9375. Wanted the name and address of the manufacturer of a [illegible], invented especially for shoes and other [illegible].

DUCK'S [illegible]

MEPHISTO
INDELIBLE COPYING
PENCILS

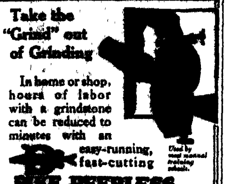
One Mephisto outlasts three ordinary copying pencils—and that's only half the story. Usually smooth writing and clear copying is the other half.

Insist on Mephisto—at your stationer's. It means pencil satisfaction, and economy as well. Two grades of lead—medium and hard.

L. & C. Hardtmuth
34 East 23d Street, New York

Take the "Grind" out of Grinding

In home or shop, hours of labor with a grindstone can be reduced to minutes with an easy-running, fast-cutting



Used by most manual training schools.

PIKE PEERLESS TOOL GRINDER

The Pike Patented Bevel Guide enables anyone to grind an edge true—and do it in record time, without drawing the temper or "burning" the steel.

Guaranteed Forever against all mechanical defects. Pike Peerless Junior, $5. Pike Peerless Senior, $7. Foot Power $1.50 extra. Other Pike grinders from $3 up at your hardware or tool dealer's. Under Pike trademark you can also get the best stone for every other sharpening need—for home as well as shop. Ask to see a Pike Kantbreak Knife Sharpener, a Pike Scythe Stone or a Pike India Oilstone (fastest cutting, longest lasting). All guaranteed. "PICK A PIKE."

FREE A Pike India Stone. Send 4c to cover packing and mailing and get a handy Pike India Vest Pocket Stone free—great for penknives, etc. Mention dealer's name and we'll also send "How to Sharpen," best book ever written on the subject. You'll be pleased. Write today.

PIKE MFG. CO., 74 Main Street, Pike, N. H.

PERPLEX
Prism Binoculars

are a revelation to any one who travels, camps, hunts or gets "out-of-doors."

New York, April 14, 1914.

Amer. Thermo Ware Co.

Gentlemen: The Binoculars have given complete satisfaction. While confined at home by my accident, I had as perfect a view of the International Motor Boat trial races on Manhasset Bay as if I had been sitting on the Club House porch or following the races in a boat. The Binoculars form a part of my equipment. I would not be without them. Yours truly, JAMES E. SULLIVAN.

Offer a thousand uses for pleasure or utility.

CATALOG "E" FREE. If dealer cannot supply, we will send direct and guarantee satisfaction.

AMERICAN THERMO WARE COMPANY
16 Warren St.
New York City

WEARING APPAREL

Shirley President Suspenders 50¢

Leave you free for every motion

"Satisfaction or money back"

[illegible]

MOTORS AND ENGINES

ELECTRIC MOTORS

[illegible]

& CO.

[illegible]

This attachment serves not only to facilitate and accelerate in a remarkable degree the first stages of violin teaching, but to make up for past negligence in musical instruction, by training the pupil to a correct position of his fingers. About nine pupils *out of ten* may be said in this connection to be wanting in the accuracy conducive to correct playing. The figures 1, 2, 3, 4 correspond to the fingers of the left hand, aside from the thumb.

On the other hand, M. Choisy has endeavored to provide a similar help to beginners in piano playing. His "auxiliary keyboard" (*clavier simplificateur*), while not claiming to be anything like a substitute for the piano itself, can be used as a makeshift for practising and keeping up the dexterity of the fingers, without any instrument, the *arrangement of the* keys being the same as on the piano. The intention of the inventor, however, was mainly to remedy a defect only too frequent in the first stages of piano instruction, viz., confusion between the various octaves. In fact, even the most talented pupils are generally unable to recognize at a glance any notes situated above or below the five lines of the note system, the more so as sol-fa exercises, as generally practised, are after all, destined only for singing lessons. While this drawback could be helped by special sol-fa practice, adapted to the requirements of piano playing, this course would be rather complicated and trying to pupil and teacher alike.

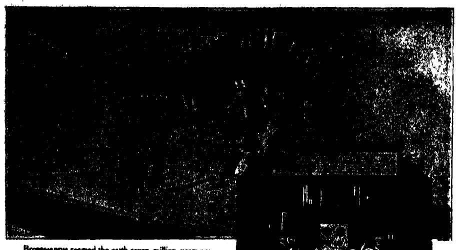
M. Choisy's auxiliary keyboard obtains the same result in a far more simple manner, and thus greatly facilitates piano teaching. It is simply applied behind, and immediately beside the piano keyboard, and will be found readily to remain in position. Inasmuch as all the notes of the instrument are inscribed on the auxiliary keyboard, the pupil, in the event of any uncertainty about a given note, will immediately find the key desired. The more he thus acquaints himself with the various octaves of the instruments, the more will he be able to do without the auxiliary keyboard, until its help can be entirely dispensed with.

Arctic Mines

APROPOS of the collieries in Spitzbergen, which have frequently been pointed out as an interesting example of mines in high latitudes, it may be worth noting that much coal from Spitzbergen is shipped to Kiruna, in Swedish Lapland, latitude 68⅓ degrees north (about the same latitude as northern Alaska), for use in operating the richest and probably the largest iron-mine in the world. According to a recent consular report, this mine is operated the year around, employs about 1,600 men, and is expected soon to be shipping 10,000,000 tons of ore per annum. About 25,000,000 tons have already been taken out. After this year the mine will be operated by electricity, the power being brought from Porjus Falls, 150 miles distant.

New Magnetic Charts of the Globe, or at least of regions of the earth embraced between 50 degrees north and 50 degrees south latitude, will, it is hoped, be published by the Department of Terrestrial Magnetism of the Carnegie Institution in 1915. They will include the three magnetic elements, declination, dip, and intensity of field, and will be referred to the date January 1st, 1910, as the middle date of all the material secured by the department and co-operating institutions during the period 1905-1915. It now seems likely that the polar regions can also be included, in view of the renewed activity in polar exploration. It has been the practice of the department to lend apparatus, train observers, and furnish instructions for all polar expeditions giving promise of serious and extensive magnetic work.

Sir Ernest Shackleton, accompanied by Messrs. Wild and Marston, members of the forthcoming antarctic expedition, will visit Norway at the end of March for the purpose of testing under polar conditions the sledges to be used by the expedition.



Brontosaurus roamed the earth seven million years ago. He could not adapt himself to changed conditions. Nature scrapped him.

One of the cases in the William J. Hammer Historical Collection in New York, which exhibits the hundreds of lamps which were scrapped before MAZDA Service gave us the MAZDA lamp of today.

Evolution and the Scrap Heap

Talks About MAZDA No. 4

"Not the name of a thing but the mark of a Service."

ABOUT seven million years ago, more or less, a stupid, slow-moving lizard known to science as *brontosaurus* roamed the earth. He stood thirty feet high on his hind feet and was seventy feet long. He weighed over thirty tons. As he lumbered along, each of his ponderous feet left a track that occupied one square yard. No one knows why he became extinct. Perhaps the earth shrugged her shoulders one day, as it were; in other words, a cataclysm occurred. Dry land became water and oceans became dry land. *Brontosaurus* could not adapt himself to the change. Nature scrapped him.

This process of scrapping is what Darwin meant by "evolution," "natural selection," and the "survival of the fittest." It is a process that finds its counterpart in the scrap heap of human industry. There are mechanical fossils as well as fossil lizards. Look in the scrap heap of any industry and you will find them. The bigger that scrap heap is, the more marked has been the evolution which it represents, the more perfect is the product of the industry. If an industry has no scrap heap it is standing still; it is not evolving.

Next to agriculture and architecture the oldest of human industries is the art of lighting. Hence the scrap heap of light producers ought to be large. And it is. Think of the hairy, low-browed savage who rubbed two sticks together, built a fire and thus made the first artificial light thousands and thousands of years ago. Then think of the incandescent electric lamp. What an evolution! What a scrap heap has been piled up of beacons, rush lights, candles and oil lamps, each with a little subsidiary scrap heap of its own, representing the evolution of its particular type of light-producer!

When the incandescent electric lamp was invented the height of the scrap heap was more than doubled. In a few years, lamps which represented the illuminating methods of centuries were discarded. And the end is not yet. The height of the scrap heap is growing more rapidly than ever.

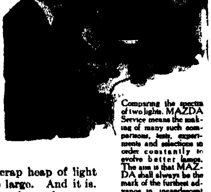
All the science of our time is epitomized in the incandescent lamp of today—the MAZDA lamp. If you knew its history you would know the history of modern science. Study its scrap heap and you learn how far the art of lighting has evolved, even in your own time.

At the very bottom of the heap you will find a lamp with a strip of graphite in a poor vacuum. Farther up are hundreds of lamps with platinum filaments, still further up lamps with filaments composed of the oxides of zirconium and titanium, and very near the present top, lamps with filaments of carbon, osmium, silicon compounds and tantalum. Then come many types of the metal filament lamp, including types of tungsten lamps.

All of them are as extinct as *Brontosaurus.*

Let it not be supposed that the lamps of today marked MAZDA are the last word in incandescent electric lighting. Some day there will be other lamps, more efficient but still marked MAZDA.

They will be so marked because they evolved from the same unceasing systematic study and selection that gave us the MAZDA of today—a study and selection centered in the Research Laboratories of the General Electric Company at Schenectady and supplemented by learning from the leading experimental lamp laboratories of the world, what progress they have made in the same direction.



Comparing the spectra of two lights. MAZDA Service means the making of many such comparisons, tests, experiments and selections in order constantly to evolve better lamps. The aim is that MAZDA shall always be the mark of the furthest advance in incandescent lighting

The results thus obtained are communicated to the General Electric Company's manufacturing centers at Cleveland and Harrison, and also to the other lamp manufacturing companies entitled to receive them. This scientific investigation and the communications of the results obtained constitute MAZDA service. All the lamps made by the companies in accordance with this service are marked MAZDA.

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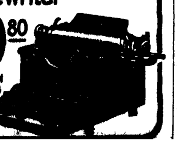

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NEW BOOKS, ETC.

THE JOB, THE MAN, THE BOSS. By Dr. Katherine M. H. Blackford and Arthur Newcomb. Illustrated from photographs. Garden City and New York: Doubleday, Page & Co.

The man behind the machine is as important a factor as the man behind the gun on board a battleship; yet weeks and even months are spent in rearranging machinery with an eye to efficiency, and not ten minutes in selecting the man who will be charged with the care of that machinery. To bring system and order where hitherto there has been either chaos, or at the best reckless choosing, is the primary object of this book.

A plea is made for two principles: The establishment of a central employment bureau in every large organization and a character analysis of each employee, proposed or actually engaged, to determine his qualifications and fitness for a particular task

The idea of a central employment bureau is one that must commend itself at once. When it is considered that shop foremen select their own men, and in so doing are frequently governed by blind prejudice, that their "hire and fire" method is not only unfair to the employee but extremely costly to the employer, there can be no question that within the next few years we will see the central employment idea firmly established. The authors have introduced it with success in several factories. In accordance with their system, shop foremen send their requisitions to the central employment bureau for men just as they send requisitions to the pattern or tool department for patterns and tools. Human material which they cannot use is sent back to be otherwise employed if possible, and not to be recklessly discharged.

As a matter of fact, very little material is actually sent back That is due to the system of character analysis which Dr Blackford has devised, a system which seeks to introduce method where hitherto there has been only guessing or intuition Beyond question, a man's psychical attributes manifest themselves physically. Low brows, thick lips, shifting eyes, square jaws, have always symbolized well-known attributes, not only in novels but in the very practical affairs of daily life. Mental and other aptitudes Dr. Blackford has classified with their physical expression (skin texture, width of head, color, etc) in a way that anyone can grasp It is a matter of great importance, as practice has shown, whether a man who applies for a particular job is long headed or round headed, blonde or brunette, convex or concave in profile, high browed or low browed, fine skinned or coarse skinned. A scientific method takes the place of mere intuition and guessing

The system as it is outlined in this book has been in successful use in many large organizations, how successful may be gathered from the fact that it has been adopted by more than one plagiarist who has palmed it off as his own No doubt as it is more widely introduced, refinements and improvements will suggest themselves, but as it stands it is the first really scientific attempt to introduce definite principles, easily grasped, where there has been nothing but folly, ignorance and injustice.

THOMAS'S REGISTER OF AMERICAN MANUFACTURERS. And First Hands in All Lines. New York: Thomas Publishing Company, 1914. Sixth edition. 2,800 pp. Price, $15.

The Register has developed into a ponderous tome very much larger than Webster's Unabridged, and presents improvements both in content and arrangement A new section has been added, containing 50,000 names in straight alphabetical order. From the name of a concern, one may thus locate its offices, branches, and line of manufacture. This list, like the main classification of the volume, carries symbols indicating the capitalization and size of the listed firm. There is no line of business that is not adequately covered by the Register. That there are more than 70,000 completely-indexed classifications is sufficient evidence that all available names, regardless of advertising patronage, are included. There is also an alphabetical list of trade names and special brands, showing the manufacturers of each. The Register affords the buyer immediate access to every possible source of supply, while to the seller it offers a compilation of possible customers with intimate information of their standing, in so far as this is indicated by money invested.

THE WORLD SET FREE. By H. G. Wells. New York: E. P. Dutton & Co., 1914.

This latest of Mr. Wells' books is a curious combination of his earliest and latest methods, for it is at once one of those magnificent flights of imagination which gave us the "Time Machine" and the "War of the Worlds," and the keen sociological perception which gave us the "New Machiavelli" and its successors. How the great world war started, how it was fought with the aid of aeroplanes and atomic bombs, how it became so terrible that the utter folly of fighting was driven home with telling horror, Mr. Wells sets forth with a vividness that stamps him as a literary artist of the first rank. To the scientist, of course, the most interesting feature of the book is the method in which the discoveries in radio-activity are given artistic treatment, a method which shows that in the hands of a master science offers possibilities that can hardly be overrated. The atomic bomb which plays so great a part in this story, although a creation of Mr. Wells, may be regarded as inspired by Soddy's "Interpretation of Radium." Wells argues that inasmuch as radio-active substances are constantly decaying and giving off energy as they do so, tremendous results could be obtained if the decay could occur with explosive rapidity. Trained scientist as he is, he presents his atomic bomb with an air of definiteness and conclusive-

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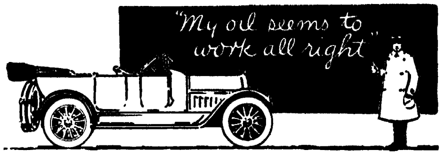
"My oil seems to work all right"

This hap-hazard expression is common among inexperienced motorists. It often brings costly penalties.

The motorist should never rest satisfied simply because he *sees* no trouble.

You cannot spare time to frequently examine your wrist-pins and bearings. Nor can you, after each run, inspect your cylinder walls and piston rings for signs of faulty lubrication.

Every good automobile motor is built to stand abuse —for a time.

No matter how inefficient your oil is, your motor for a while will "seem to work all right."

But high fuel bills often point to power-waste—sometimes directly due to incorrect oil.

And the poorly-lubricated motor which "seemed to work all right" too-commonly is headed for the repair shop.

Lubricating oil, to prevent power-waste and premature motor wear, *must* have two qualities.

(1) Its *body* must be suited to your feed system, piston-clearance, bearing design and many other important factors which differ with different motors.

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How can you make sure that your lubricant is correct in body and high in quality?

A safe, scientific guide will be found in the carefully-studied recommendations listed in the Lubricating Chart printed in part at the right. Each recommendation in this chart was made after a careful engineering analysis of the car's motor.

For a number of years this Chart has been the standard scientific guide to correct lubrication.

A copy of our complete Chart will be sent you on request

On request we will also mail a pamphlet on the Construction, Operation and Lubrication of Automobile Engines It describes in detail common engine troubles and gives their causes and remedies.

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Correct Lubrication

Explanation In the schedule, the letter opposite the car indicates the grade of Gargoyle Mobiloil that should be used For example "A" means "Gargoyle Mobiloil A" "Arc" means "Gargoyle Mobiloil Arctic" For all electric vehicles use Gargoyle Mobiloil "A" The recommendations cover all models of both pleasure and commercial vehicles unless otherwise noted

MODEL OF	1910		1911		1912		1913		1914	
CARS	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Abbott Detroit	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
Alco	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
American	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Autocar (2 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
(4 cyl.)	A	E	A	Arc	A	Arc				
Avery	A	E	A	E	A	A	A	A	A	A
(Model C)									Arc	Arc
Buick (2 cyl.)	A	A	A	A	A	A	A	A		
(4 cyl.)	Arc	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (6 cyl.)									A	Arc
Cadillac	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cartercar	A	E	A	E	A	E	A	E	Arc	Arc
Com'l	A	E	A	Arc	A	Arc	A	Arc		
Case			A	A	A	Arc	A	Arc	A	Arc
Chalmers	Arc	Arc	A	Arc	Arc	Arc	Arc	Arc	A	A
Chase (air)	B	B	B	B	B	B	B	B	B	B
" (water)									Arc	Arc
Cole	Arc	Arc	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Delaunay Belleville	B	A	B	A	B	A	B	A	B	A
E. M. F.	Arc	Arc	Arc	Arc	Arc	Arc				
Empire	A	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
Fiat	A	A	B	A	A	A	B	A	B	A
Flanders	E	E	E	E	Arc	Arc				
(6 cyl.)							Arc	Arc		
Ford	A	Arc	E	E	E	E	E	E	E	E
Franklin	B	Arc	A	Arc	A	Arc	A	Arc	A	A
Com'l	B	A	B	A	A	Arc	A	Arc		
G. M. C. Truck					Arc	Arc	A	Arc	A	Arc
Havers			A	Arc	A	Arc	A	Arc	A	A
" (Model 6-60)									Arc	Arc
Haynes	A	E	A	Arc	A	Arc	A	Arc	A	Arc
Hudson	Arc	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Hupmobile (Model 20)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
(Model 32)							A	Arc	A	Arc
I. H. C. (air)							B	A	B	A
(water)							A	A	A	A
International	B	A	B	B	B	A				
Interstate	A	E	A	Arc	A	Arc	A	Arc		
Jackson (2 cyl.)	A	A								
(4 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
(6 cyl.)									Arc	Arc
Jeffery									A	A
Com'l					Arc	Arc	Arc	Arc	Arc	Arc
Kelly			Arc	Arc	Arc	Arc	Arc	Arc	A	A
King			A	E	A	E	A	E	A	A
" Com'l									Arc	Arc
Kissel Kar	A	E	A	Arc	A	Arc	A	Arc	Arc	Arc
" Com'l			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Model 48)									A	A
Kline Kar	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Knox	B	A	B	A	B	A	B	A	B	A
Krit	A	A	A	A	A	A	A	A	A	A
Locomobile	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	E	E
Lozier	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Mack	A	E	A	E	E	E	E	E	A	E
" (Model 8)							A	A	A	A
Marion	A	E	A	E	A	Arc	A	Arc	Arc	Arc
Marmon	A	E	A	Arc	A	Arc	A	Arc	A	Arc
Maxwell (2 cyl.)	E	E	E	E	E	E				
(4 cyl.)	E	E	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
(6 cyl.)							Arc	Arc	Arc	Arc
Mercer	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Mitchell	Arc	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Moline	A	E	A	Arc	A	Arc	A	Arc		
Moline Knight									A	A
Moon (4 cyl.)	A	E	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" (6 cyl.)									Arc	Arc
National	A	A	A	A	A	A	A	A	A	A
Oakland	A	E	A	Arc	A	Arc	A	Arc	Arc	Arc
Oldsmobile	A	E	A	Arc	A	Arc	Arc	Arc	Arc	Arc
Overland	A	E	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Packard	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Paige Detroit	E	E	A	Arc	A	E	A	E	A	A
Pathfinder							A	Arc	Arc	Arc
Peerless	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Pierce Arrow	Arc	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
" " Com'l			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Pope Hartford	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Rambler	A	A	A	Arc	Arc	Arc	Arc	Arc		
Regal	A	E	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Renault	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Reo	A	E	A	Arc	A	Arc	A	Arc	A	Arc
Saxon									E	E
S. G. V.			B	Arc	B	Arc	B	Arc	A	Arc
Selden	A	E	A	E	Arc	Arc	Arc	Arc	Arc	Arc
Simplex	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Speedwell	Arc	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
" Mead							A	Arc	B	A
Stearns	Arc	Arc	A	Arc	A	Arc				
" Knight					A	A	A	A	B	A
Stevens Duryea	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Stoddard Dayton	Arc	Arc	A	A	A	A	A	A		
" " Knight					A	A	A	A		
Studebaker	E	E	A	Arc	Arc	Arc	A	Arc	A	Arc
Stutz					Arc	Arc	Arc	Arc	A	A
Velie (4 cyl.)	A	E	A	Arc	A	Arc	A	Arc	A	Arc
" (6 cyl.)									Arc	Arc
Walter	A	E	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

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Scientific American Supplement No. 1713—*Brazing Cast Iron and Other Metals,* gives detailed instructions for the whole operation, and formulas.

Scientific American Supplement No. 1644—*Soldering and Soldering Processes,* gives broad general information, and contains in particular a method for pulverizing solders and alloys of great use.

Scientific American Supplement No 1667—*Some Soldering Appliances,* describes the blow-pipe and the furnace in their various forms.

Scientific American Supplement No. 1481—*Soldering of Metals and Preparation of Solders* gives many formulas for soft and hard solders and fluxes.

Scientific American Supplement Nos. 1610, 1622, 1628 contain a series of three articles on Solders, covering the entire range of solders for all metals No. 1628 contains formulas for *soldering aluminium.*

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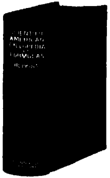

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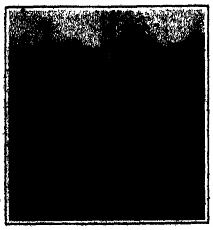
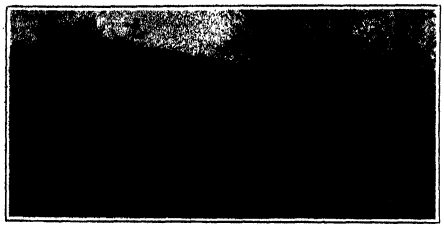
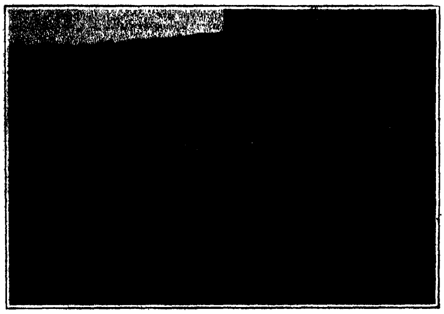


Grading into different height classes.

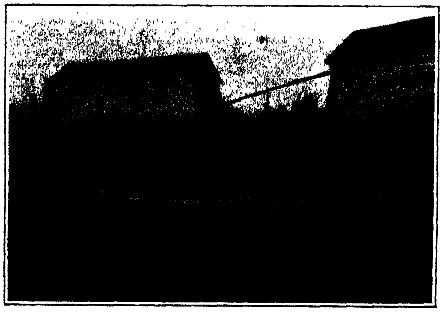


Drying and bleaching peeled willows.

Peeling the willow rods.



Tying the peeled rods into bundles for storage or shipment.



Bundles of American green willows in the pit ready to be peeled.

Basket Willow Culture in the United States

BASKET willows are of European origin and are now cultivated in all temperate climates. They thrive as far north as Norway and Sweden, and have been naturalized in portions of North and South America, Australia, and New Zealand. They are grown extensively in Great Britain, France, Belgium, Holland, Germany, Austria, and Russia. The chief producing districts of Europe are Germany, Holland, and France, where the conditions are particularly adapted to willows. These are highly esteemed by American basket makers, who use several thousand tons of imported rods annually. Willows grown in Belgium are also among the finest, but they are usually larger and suited principally for coarser basket ware.

There are many kinds of basket willows in cultivation, and much confusion exists in their classification. About ninety-five different strains considered valuable commercially are known in Europe. The varieties now most in use in this country are purple willow (*Salix purpurea*), American green willow (*Salix amygdalina*), Lemley willow (*Salix pruinosa*), and Patent Lemley willow (*Salix pruinosa acutifolia*). The purple willow is by far the best variety for American conditions, and it has been grown successfully from Maine to Minnesota and southward to Kentucky and Tennessee. It readily adapts itself to a great variety of climatic and soil conditions and produces tough, pliable rods much sought by basket makers. Climate and soil have much to do with the successful cultivation of willows. In regions with a mild and humid atmosphere the best length of rods and, therefore, the greatest yield per acre is obtained. Loose, rich, and moist sandy loam soil is most congenial to their growth. Willows may be grown in any part of the United States where these soil conditions obtain, and when rationally treated no other crop gives more profit. The difference in quality of willow rods does not arise so much from the difference in kind as it does from the result of soil and general treatment. The same variety will produce good, long flexible rods in one part of the plantation, while in another they may be short, brittle, and branching.

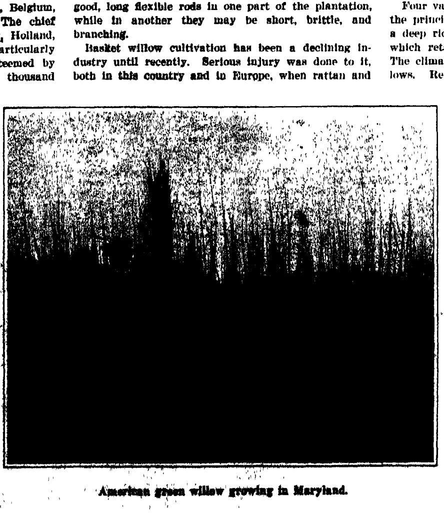
Basket willow cultivation has been a declining industry until recently. Serious injury was done to it, both in this country and in Europe, when rattan and other substitutes began to be introduced. The prevailing low prices of splint baskets and sea-grass furniture are also factors in its decline. The demand for willows is again increasing, and a brief discussion of their culture followed in the willow-growing districts should, therefore, be of interest.

Four varieties are grown in northern New York, but the principal kind is the purple. The soil chosen is a deep rich humus with a moderate amount of sand, which retains the required amount of soil moisture. The climatic conditions are likewise favorable to willows. Reports covering ten years show an average annual rainfall of 35 inches. This amount of moisture is an essential condition for the attainment of a good crop The willow zone of northern New York is thus largely determined by the peculiar character of the soil

The ground is prepared so as to clean it of weeds, and place it in a condition to facilitate the wide penetration of the roots of the willow, and also to conserve moisture during hot weather. The success of this work, like in all other undertakings, depends upon the management, which must be in the hands of men who are able personally to direct the work and who have at the same time a material interest in the welfare of the plantation In New York most willow plantations are owned by farmers who cultivate and harvest their own crops. No systematic method of manuring has as yet been undertaken. A few growers use well-rotted barnyard manure and spread it between the rows and work it in the upper stratum.

Cuttings are planted early in March, and the operation is intrusted only to those who have knowledge of the work. The length of the cuttings should vary

(Concluded on page 453.)



American green willow growing in Maryland.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement

Latin-American Attitude to the United States

FOR the reason that we believe it represents the attitude of the intelligent Latin-Americans toward the foreign policy of the United States, at least so far as it affects the Western Hemisphere, we publish with much pleasure, and direct special attention to the letter from a correspondent in Cuba, which will be found on our correspondence page. The writer has appreciated at their full value the motives and convictions which prompted our publication of the series of articles entitled "The Problem of Our Navy;" and we believe that if toll could be taken of the opinion of the more intelligent citizens of the Latin-American countries, it would be found that there is a general appreciation of the fact that the best guarantee of the inviolability of the New World against armed aggression by the nations of the Old World, is the possession by the United States of a fleet of such power, and in a condition of such thorough preparedness, that none of the navies of the Old World could measure arms with it, in the waters of the Western Hemisphere, without running the risk of a defeat

It is discouraging, in view of what we have done in Cuba, to realize that there is a certain amount of distrust of the United States existing among the great mass of the people of the Latin-American republics As an instance of disinterested and highly idealistic attitude toward a weaker state, the United States may point to the history of our relations with Cuba with a pride which is altogether justifiable. We entered that distracted island for the express purpose of regulating its many disorders and with the definite statement that we had no wish to permanently occupy territory, and with a pledge, further, to withdraw our forces as soon as a stable government had been established. That pledge we have fulfilled to the letter; and Cuba stands to-day as an undeniable proof of the fact, first, that the attitude of the Government of this country to the rest of Latin-America is altruistic, in so far as we earnestly desire to see it prosper under strong, independent, and capable governments; second, that our attitude is egotistic only so far as our Government realizes that the abolition of revolutions, the harmonizing of contending factions and the setting up of orderly governments, conduces to the prosperity of the United States and promotes the advancement and solidarity of the Western Hemisphere as a whole.

Air and Water Resistance of the Racing Yacht

THE resistances which have to be overcome in getting speed out of a racing yacht, especially if she is going to windward, may be broadly divided into those which are encountered respectively above and below the water-line. Although by far the greater part of the sail power is expended in driving the hull through the water, not a little of it (much more than would be generally supposed) is absorbed in forcing the towering superstructure of sail, mast, and wire rigging against the wind.

Although it may seem paradoxical to say that the wind power which drives the yacht forward tends also to hold her back, it is a fact that when a yacht is close-hauled or heading into the wind, the head resistance of the wind and its skin-friction along the sails, total up a very considerable amount When a yacht is making 10 knots against a 25-knot wind, the resultant wind velocity through her rigging will be about 30 knots. This is well understood by the yacht designer; and, during the races of the past fifteen years, great attention has been paid to this element of the problem. It so happens that the constant endeavor to save weight aloft, by the substitution of hollow steel masts and steel wire for wooden masts and manila rope, has also tended to reduce dimensions, and so cut down head-wind resistance. When we bear in mind that the standing and running gear of a modern racing yacht will total up from 2,500 to 3,000, or even 3,500 linear feet, and that the mast of an "America" cup yacht will present a total square surface of nearly 200 square feet to the wind, it will be understood that, in races that are sometimes won by seconds, the question of wind resistance is an important one. In addition to head resistance there is the skin-friction of the wind along the sails, and it is somewhat in the effort to lessen this that in a modern yacht the cloths of the sails are run approximately horizontally, so that the flow of the wind may be more along the seams than across them.

The resistance of the hull may be classified under wave-making; eddy-making; suction or drag; and skin resistance. Wave-making is the most important element of resistance at the higher speeds, and increases very rapidly with the increase of speed; in light airs and at the lower speeds skin resistance, or the friction of the water against the wetted surface of the hull, is the more important. Wave-making is due to the rapid displacement of the water as the yacht progresses, and its magnitude for a given speed is, of course, greatly affected by the underwater model of the yacht. At the higher speeds a mass of water is continually being lifted in the form of waves to a certain height above the general water level. This means that work is being done upon the water, and that a proportional amount of the driving energy of the wind is being thus absorbed. If there is anything wrong with the model of the yacht, especially in her run and quarters, and the stern wave does not rise snugly along the quarters, but follows several feet astern of the yacht, there will be heavy drag, and she will tend to pull a certain amount of water after her, and this will mean a further consumption of energy.

The designing of a yacht, such as those which contend for the "America's" cup, is complicated by the fact that the weather conditions throughout a season's yachting will vary from gentle airs to very strong winds; and the most successful yacht, other things being equal, will be the one that maintains the best mean speed under the average of all weather conditions.

Past experience, extending over more than a quarter of a century, has proved that on the race course off Sandy Hook the prevailing winds are light; and hence, of two well-designed and equally well-sailed yachts, the one which presents the largest amount of sail area per square foot of wetted surface should prove to be the winner of a series of races—this for the reason that, at moderate speeds, the skin friction is the most important element of resistance. Our American yacht designers seem to have recognized this fact, or, at least, they have paid more attention to it than the British challengers; for it is a fact that, with sheets started, in light airs, our yachts have always won out by a handsome margin. In the one case in which the challenger has pulled away from the home boat when running before the wind ("Shamrock II" versus "Columbia"), the "Shamrock" spread about 1,000 square feet more of canvas than "Columbia" above a hull which probably had somewhat less wetted surface.

There is one other element of resistance, the importance of which can scarcely be over-estimated, and that is the drag due to the rudder. Theoretically, in a properly designed yacht, in which the center of wind pressure is in the correct position with regard to the center of the vertical underwater plane of the hull, the rudder, even when the yacht is sailing close-hauled, should be practically amidships. The least putting over of the helm produces a corresponding drag upon the hull, with a resulting loss of speed. A well-balanced yacht should carry a slight weather helm in going to windward; but an experienced captain will pay such close attention to the trim of his sails that he will practically eliminate this; and it is our belief that the remarkable results obtained by the late Capt. Barr in working to windward in light airs, was largely due to his appreciation of this fact.

The Protection of Our Migratory Birds

OUR farmers suffer a loss of $800,000,000 annually from the ravages of the boll-weevil, the gypsy moth, the Colorado beetle, the rush fly, the codling moth, the white scale, and many other pernicious insects. Congress has from time to time authorized the expenditure of millions for the extermination of these pests, and yet Congress hesitates adequately to protect birds which are known to be the natural enemies of destructive insects.

Most insects like the green leaf louse, or aphis, so ruinous to the hop industry, and many other of our most valuable fruits and vegetables, reproduce their kind at the rate of ten sextillion to the pair in one season. The natural increase of one pair of gypsy moths would defoliage the United States in eight years. Locusts, army worms, and chinch bugs, unless checked in procreation, soon become countless hordes, devastating wide areas of the earth's surface. Dr. Lintner of the New Jersey Board of Agriculture reports that one hundred and seventy-six species of insects attack the apple tree. Approximately the same number attack peach, plum, and cherry trees. Dr. Packard finds four hundred species feeding upon the oak; and three hundred attacking the conifers. The number feeding upon cereals, grains, and garden crops is huge. Dr. Marlatt estimates that the loss to the wheat-growing States in 1904, occasioned by the Hessian fly, was about $50,000,000, and Dr. Shinar places the damage done to crops in the Mississippi Valley by the chinch bug in one year as high as $100,000,000. The Rocky Mountain locust, during the years of its greatest activity, caused a loss to the States of the Northwest of more than $150,000,000. Cut worms, Dr. Lintner assures us, mean an annual loss to farmers of $100,000,000. Clearly, it is not a gross exaggeration to place the damage to our crops and fruit trees at $800,000,000 annually.

Under most State laws, local game is adequately protected; for the average open season does not exceed six weeks, and often no shooting or fishing is allowed for several years. With migratory birds the open season often exceeds eight or nine months. This means eventual extermination under State regulations, and with the destruction of wild fowl and insectivorous birds the entire nation suffers. Each woodpecker is worth $20 to this country, according to the Department of Agriculture.

Certain varieties of snipe are now extinct, and the remainder, but a straggling remnant, is still being shot ten months in the year. In 1857, an Ohio's Senate Committee's report stated: "The passenger pigeon needs no protection." Fifty-five years after this was written the bird which existed in countless millions became totally extinct.

At one season of the year practically all the ducks of the United States are crowded in the marshes and swamps of Louisiana and Florida; for there food is abundant. Hence, it is difficult to convince the people of the South that there is any scarcity of wild water fowl. The official record of wild fowl killed in Louisiana during the season of 1910 is as follows: Wild ducks, sea and river, 3,176,000; coots, 280,740; geese and brant, 202,210; snipe and plover, 696,635. At this rate our migratory birds will be extinct in a few decades.

The early idea predominated that any restriction imposed upon the right to make assaults upon nature's storehouse was a restriction and an abridgment of human liberty and, therefore, hostile to the principles of free government. More recently the American people have become thoroughly awakened to the imperative necessity of conserving our natural resources, and among those resources wild birds are not the least important.

The Weeks-Maclean law is intended to protect our migratory birds, but Congress has manifested no great desire to make it effective by appropriating a suitable sum for its enforcement. The sum of $100,000 which was asked will not provide even a single Federal warden for every State. It takes about $2,500 to cover the annual pay and traveling expenses of such an official. On the other hand, to prevent the adulteration of Paris green and other insecticides Congress appropriates $95,000; to establish an agricultural experiment station on the island of Guam, $15,000; to fight gypsy and brown-tail moths, $297,540; to fight cotton boll-weevil and for farmers' co-operative demonstrations, $628,240; improvement of tobacco, $28,000; investigation of plant diseases, including diseases of ginseng, etc., $37,000. The protection of migratory birds is no less important than the erection of a station at Guam, or the prevention of adulteration of insecticides.

The Canadian government has prohibited the shooting of wild fowl in all its great Provinces, and it expects this Government to do likewise. Neither country is concerned about the State or provincial laws, regulating the shooting of local birds in the home district of their neighbor, but much interested in proper laws for the preservation of game in which each has an interest and a duty. Fully 75 per cent of the migratory game birds are raised in Canada; yet American game butchers, immediately beyond the Canadian border line and along the passage of migratory flight, claim the legal right of exterminating birds as they see fit.

Thanks to the activities of the American Game Protective Association, there is every prospect that a treaty will be enacted between the United States and Great Britain which will stop the reckless slaughter of migratory birds that has gone unchecked for generations on the North American continent. When that treaty is ratified migratory birds will be protected during nearly the complete line of their flight.

Engineering

Launching of Cup-Defender "Defiance."—"Defiance," designed by Owen, built at the Bath Iron Works, and launched at the yards of this company, is now under sail. The yacht has been built by what is known as the tri-city syndicate, of which Mr. George S. Pynchon is chairman. She is of composite construction, with steel frames covered by two thicknesses of wood, one of fir, the other of mahogany. A full description of the yacht appeared in our issues of May 2nd and May 9th.

The Destroyer "MacDougal" Makes 32.07 Knots.—While running her standardization trials the new destroyer "MacDougal," built at the Bath Iron Works, made a maximum speed of 32.07 knots for one mile and averaged for five full-speed runs 31.52 knots. The "MacDougal", measures 300 feet on the water-line, 30½ feet beam, 9 feet 5 inches draft, and displacement is 1,025 tons. She is armed with four 4-inch 50-caliber guns and eight 18-inch torpedo tubes. She is an oil burner, carrying a supply of 309 tons of oil.

Behavior of Concrete in Sea Water.—In 1909 several reinforced concrete posts made from different materials of different proportions and in varying degrees of thickness, were submerged in sea water at Boston, where they have been exposed to tide variations and ice conditions. A recent booklet of the Aberthaw Construction Company of that city states that thus far it has been determined that a dense concrete will better resist the combined physical and chemical action of sea water, flotsam and ice than will a porous concrete.

Alaskan Engineering Commission.—President Wilson has appointed the members of the commission which is to have charge of the location and construction of Government railways to be built in Alaska. The commission consists of Messrs. Edes, Mears and Riggs, who are now on their way to Seward, Alaska, which will form the headquarters for the Summer. The first work to be done will be the survey of a route from Portage Bay to the vicinity of Fairbanks. Applicants for work on the engineering force should address the Alaskan Engineering Commission, Department of the Interior, Washington, D. C.

An Ancient Horse-drawn Train Service.—According to the *Engineer*, it was only last month that there was brought to a close a passenger train service maintained by horse traction, which has been in continual operation since the year 1856. The stretch of line affected is a portion of the North British Railway, lying between Drumburgh Junction, a few miles west of Carlisle, and Port Carlisle, a seaport on the Solway Firth. The line was operated by locomotives from 1854 to 1856, and in August of the latter year horses were substituted. They have been in continuous use up to the present year, when they were superseded by steam locomotives.

A 113-mile Electrification of a Steam Railroad.—The Chicago, Milwaukee & St. Paul Railroad is about to electrify a portion of a 440-mile stretch of railroad across the Belt, Rocky and Route Mountain ranges. The first section will be 113 miles in length. Direct-current, 2,400-volt traction will be adopted, and regenerative electric braking will be used instead of the customary air braking. The section will be operated with twelve 200-ton freight locomotives, four 200-ton through passenger locomotives and two 100-ton local passenger locomotives. The estimated cost of the installation is $1,500,000, exclusive, of course, of the cost of the locomotives.

The Stress of Sea Waves.—In his recent lecture before the Royal Institution at London, on modern ships, Sir John Lyle drew attention to the fact that, when the waves are one half the length of the ship and one twentieth of the length in height, the stress upon the ship itself was very little increased above that in smooth water. But when the waves are of the same length as the ship, or one and one half times its length, the stresses are considerably higher than when the ship is in smooth water. Hence, in view of the fact that waves are seldom over 500 feet long, the maximum bending moments which come upon a ship 900 feet long, such as the "Aquitania," are much less than those which come upon one 500 feet in length.

Canal-Boat Elevator.—A somewhat original construction in the shape of a canal-boat elevator is in use on one of the canals in the north of France which connects the ports of Dunkerque and Calais with the industrial and mining region. It consists of two metallic basins lying side by side and about 130 feet in length. Each tank is carried on a vertical hydraulic piston, one tank rising while the second one falls. Connection with the ends of the canal is made by a system of gates and also a rubber tube joint between tank and canal end, the rubber tube being filled out by compressed air so as to make a tight joint, whereupon the gates are opened. One tank being at the top and the second at the bottom, the joint is made at the top tank, the gates withdrawn, and water enters the top tank to the level of 8 feet. After the canal-boat is run into the tank the gates are closed.

Science

The Preparation of Eye-Preserving Glass for Spectacles.—Sir William Crookes recently read a paper before the Royal Society of London, in which he points out how the injurious ultra-violet rays of the sun may be cut off so as to protect the eyes in tropical countries. Experiments made by Sir William to protect the eyes of blowers of glass vessels resulted in the discovery of a composition of glass, sage green in color, that cuts off 98 per cent of the heat rays. This glass is composed of ferrous oxalate, soda flux, red tartar and powdered wood charcoal. Sir William's experiments showed that it was possible to make no less than six different glasses to shield the eyes from heat rays. Sir William gives complete details, and explains how the glasses are made in his paper.

The Roosevelt South American Trophies.—Most of the 2,500 specimens of big game, mammals and birds bagged by George K. Cherrie and Leo E. Miller, members of the Roosevelt-Rondon expedition, have arrived at the American Museum of Natural History. Many of the specimens in the collection are new to the museum, and possibly some are new to science. Mr. Miller, mammalogist of the party, covered some 3,000 miles in exploration and collecting trophies for the museum. He first went up the Paraguay in steamers and launches as far as the river was navigable, and then he proceeded on a 500-mile jaunt over land, traveling on muleback. For forty days he journeyed through a country with little vegetation and through a desert-like region.

Piano Touch.—It is usually considered that no mechanical piano player, however excellently constructed, can reproduce the exact efforts produced by human touch. From the analysis of Prof. Bryan, it would appear that this belief must yield to scientific analysis. He analyses the precise meaning to be attached to "touch," and shows that it may be perfectly reproduced on a pneumatic piano by means of an auxiliary lever which operates directly on the bellows, and is regulated by a sliding weight gliding on the lever itself, or by the direct pressure of the hand. The analysis is very thorough and scientific, and it is perhaps a mere confession of human weakness to say that it does not entirely convince one who has heard Pachmann play Chopin.

The Brazilian Expedition of the University of Pennsylvania, under Dr. W. C. Farabee, has completed a year of arduous and remarkably fruitful explorations, the first of which were made along some of the northern tributaries of the Amazon beyond the limits of previous exploration, while the more recent work has been done in the highlands lying on the frontier between Brazil and the Guianas. Last November Dr. Farabee started from Dadanawa with 40 native carriers on an easterly march through completely unknown territory, in the course of which he discovered several new tribes, none of which had ever before seen white men, guns, clothing or matches. The natives of this region are among the most primitive savages in the world. The explorers reached Georgetown, British Guiana, April 19th.

The Sedov Relief Expedition which the Russian government is sending north this Summer now gives promise of being a more elaborate undertaking than was originally contemplated, and, whether it succeeds or not in finding Capt. Sedov and his companions, will probably achieve interesting geographical results. It will consist of the steamers "Hertha" and "Andromeda" and the motor-vessel "Tatiana." These boats will first visit the Pancratiev Islands, off the coast of Nova Zembla, the last known location of Sedov's party, and the place from which he expected to start last Summer for Franz Josef Land. If he is not still there, the "Hertha" will take the stores from the "Tatiana," together with dogs and sledges, and endeavor to reach Franz Josef Land, while the "Andromeda" will cruise north along the coast of Nova Zembla, and the "Tatiana" will return to Archangel. The "Hertha" may find it necessary to Winter in Franz Josef Land. Her equipment includes a hydroaeroplane.

The Stackhouse Antarctic Expedition will not be able to leave England in August, as was originally intended, and may be postponed until next year. The earlier announcements regarding this expedition indicated that its principal object was to be the exploration of King Edward VII. Land, but the plans appear to have been gradually modified with the progress of time. The latest announcement is that the expedition will first land a party of twelve men on Graham Land to carry on scientific work there, while the ship will proceed along the coast, and probably winter somewhere near Prince Regent Luitpold Land, where the Austrian expedition under König, and the British expedition under Shackleton, also expect to have their Winter quarters. In the Antarctic Spring of 1915, it is proposed to have the ship pick up the Graham Land party, and, after coaling at Deception Island, to survey the west coast of Graham Land, and pass the next Winter in the neighborhood of Charcot Land. The following season, an attempt will be made to trace the supposed coast-line all the way west to King Edward VII. Land.

Automobile

An Improved Carbureter.—Patent No. 1,092,953 to Augustus M. Sanborn of Stanford University, Cal., is for a carbureter in which the hydrocarbon is mechanically projected into the air current in the form of a circumferential spray.

Puncturing Tires to Stop Automobiles.—Automobiles do not always stop when ordered by constables or other law officers, and Constant Le Duc of Chatsworth, N. J., in patent No. 1,094,226 provides an implement which can be extended so as to bring it into the path of a vehicle. The spurs on the implement will puncture the pneumatic tires, thus bringing the vehicle to a stop.

Motor 'Bus Service in Saxony.—The Saxony government has appropriated the sum of $450,000 for the purpose of extending the working length of its State motor omnibus lines from 200 to 700 kilometers. Nineteen new lines will be established and two private lines taken over; an existing State passenger line also is to be taken over and extended for the transportation of merchandise.

Another American Knight Patent Issued.—After having been in the mills of the United States Patent Office for eight years—the application was made in 1906—patent No. 1,090,991 has but recently been issued to Charles Y. Knight, the inventor of the sleeve valve engine that bears his name. The patent supplements another issued in 1910 and covering a single sleeve valve engine. The new patent, which has 43 claims, covers the well-known Knight sleeve valve mechanism and also deals with an improved lubrication system.

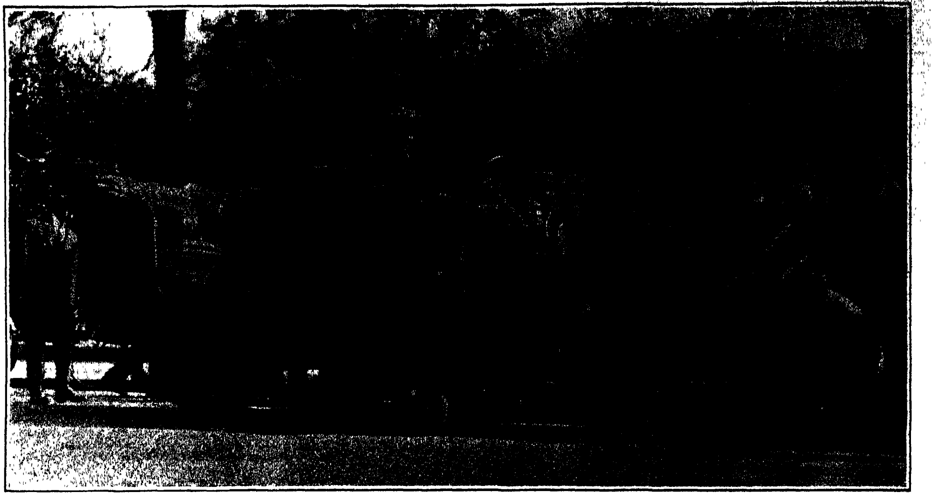
Fenders Leave Something to be Desired.—After having had ample time in which to test out the efficiency of the fenders required by law on commercial vehicles in the city of Detroit, owners of vehicles and drivers are practically unanimous that they are not of much use in preventing accidents—for which they were intended—and that they hamper the movements of the vehicles. It is pointed out in particular that the use of fenders considerably increases the over-all length of the vehicle and so shortens its turning radius; furthermore, fenders are easily damaged.

Use of Compressed Air in Steel Hardening.—Recently there has been adopted in a foreign motor car factory a new method of hardening steel with jets of compressed air. The usual method of hardening steel by immersion in oil or water or alkaline baths, it is said, results in the formation of a line of considerable tension between the hardened and unhardened parts. By the use of compressed air, however, the zones of cooling may be carefully graduated and much better results obtained. By adapting the shape of the nozzle to the work, a wide range of results is possible.

Horses are Really Going.—The statement "the horse must go" has been reiterated so often that it no longer attracts attention. But the horse really is going—and going fast. Of thirty-one principal American cities, sixteen show a noteworthy decrease in the number of licensed horse-drawn vehicles in relation to population. The percentages of decrease in seven of these cities, as collected by an organization of horse interests, are suggestive. They are as follows: Indianapolis, 11.5; Columbus, Ohio, 5.9; San Francisco, 4.8; St. Louis, 2.4, Omaha, 2.1; New York, 0.8; Chicago, 0.5. In the other nine cities the average decrease has been 2 per cent, whereas the average increase in population has been 7.8 per cent per year.

Foot-operated Gear Shifter.—The electric gear shifter now has become fairly common and there are several devices of the kind operated by compressed air. Now, however, there has appeared another which is operated by the movement of the clutch pedal. It has just been placed upon the market. The apparatus consists of a selector which is placed adjacent to the steering wheel, the shifting mechanism itself weighing about 10 pounds and attaching directly to the gear box. In operation, the driver selects the gear he desires, and the subsequent depression of the clutch pedal shifts the gears automatically. If a gear selected is not wanted, and it is deemed expedient to use another, the selection of the other disengages the first.

Novel Type of Cyclecar Drive.—There has been placed upon the market lately a cyclecar which has an unusually novel method of power transmission. The vehicle is propelled through one front wheel and not, as ordinarily is the case, through two rear wheels. To obtain the necessary changes in gear ratio there is a friction transmission mechanism in which the driving plate is the front of the flywheel, which, in this case, is ahead of instead of behind the engine. The driven member of the transmission is slidably mounted, so that it can be shifted across the face of the driving disk, and is connected to the front wheel drive through the intermediary of a universal joint and internal spur gearing within the wheel hub. It is claimed that ample traction is obtained and that skidding is avoided for the reason that the propelling power is a pull rather than a push.



The Schilowsky monotrack automobile.

The Principle of the Bicycle Applied to the Motor Car

A Two-wheeled Automobile Stabilized by Means of a Gyroscope

THE gyroscope and its applications need no introduction to our readers Its use for stabilizing ships, for steadying torpedoes and for ships' compasses, are all well known. Efforts have also been made to adapt the gyroscope for the automatic stabilizing of aeroplanes. Its use by Brennan to maintain the equilibrium of a monorail car is fresh in our memories. The latest development is a two-wheeled automobile, designed by the Russian engineer, P Schilowski, which is kept balanced by a gyroscope mounted on the machine. The car is shown in the accompanying halftone illustration It is a full-size vehicle, capable of carrying from four to six people on an ordinary road track

Its inventor, in a paper recently presented before the Royal Institute of London, summed up in the following words some of his conclusions relating to the principles to be observed in the design of such cars

The most desirable method of suspension of a gyroscope for stabilizing a monorail or a monotrack car is suspension below the center of gravity of the wheel, or neutral suspension with a top load, as it permits of the vehicle taking smooth curves in each direction Increasing the instability of the gyroscope, by adding to the top load, allows the vehicle to take sharper curves.

A special device for hurrying up the precession is unavoidable in any gyroscopic vehicle which must take sharp curves in the same direction as the rotation of the flywheel

However the gyroscope may be mounted, and in whatever direction the vehicle must run, in order to maintain the equilibrium of unstable bodies for any length of time, it is absolutely necessary to apply a *precessional system for restoring the plane of the wheel* whenever precession takes place, and it is not sufficient to increase the stability of the gyroscope by only increasing the speed. The only instance in which a device for hurrying up the precession is not required to bring back the gyroscope to its normal position, after it has been disturbed, is that of the common peg top spinning on a rough surface. In this case, the gyroscope must be entirely free of any support or mechanism, and the friction between the rounded axle and the surface on which the top is spinning automatically hurries up the precession and the top rises again.

The car, when running at a high speed, can with safety only take a curve increasing gradually in steepness Beyond a certain point dangerous oscillatory disturbances would be produced. Here we come into conflict with statements which are often found in technical books, that gyroscopic vehicles can, by their very nature, take the sharpest of curves. As a matter of fact, if a sharp bend has to be made, the curve must be gradually increased somewhat after the manner of a parabola or ellipse.

The details of the gyroscope mechanism are illustrated in the accompanying diagrams. For these and the data relating to them we are indebted to *The Engineer* They relate strictly to a monorail car, built by Mr. Schilowsky, but the principle is exactly the same as that employed in the bicycle-automobile.

Starting with Fig. 1, we have here a cross-section of the car, *A* being the central girder and *B B* the side frames. On the girder *A* and directly over the center line of the car wheels *C* a pillar *D* is erected At its top this pillar carries rigidly two parallel arms *E E* Two pendulums *F F* are hung from these arms, the bobs *G* of which consist of cylinders having their axes parallel with the longitudinal axis of the car. To the cross arms *E* two cords *H* are attached. These cords, passing vertically downward, are accommodated in shallow grooves running round the circumference of the bobs, and are thereafter taken round pulleys *J* journaled on the frames *B*. From these pulleys the cords pass vertically upward. When the car is on an "even keel" the cords are required just to touch the bottom of the grooves on the bobs. For facilitating adjustment in this respect the ends of the cords are attached to lever arms *K* formed on spindles pivoted between the members *E*. Opposed arms on these spindles are acted upon by the ends of small screw handles *L*.

Coming now to Fig. 2, an elevation of the left-hand side of the car, we have the side frame at *B*, the pendulum bob at *G*, and the cord at *H*. It will be understood that in every respect the right-hand side mechanism is the duplicate of that on the left. The cord *H* is connected through a spring to the end of a lever *M* pivoted at *N* to a standard *P* erected on the side frame *B*. The lever *M* extends beyond the pivot *N* and at *Q* is pin jointed to an arm carrying a segmental rack *R*. A rod *S* connected to this arm extends backward and passes through a bush carried at the top of a standard *T* fixed to the side frame *B*. On each side of the bush the rod is provided with a spring and a collar. *U* is a pinion which will be referred to later on *V* is a spring which is attached to the lever *M* and the standard *P*, and which serves to keep the cord *H* taut.

Let the car swing over to the right-hand side. The right-hand bob *G* will leave its cord *H* (see Fig. 1) and the left-hand bob will press against its cord. The pressure on this cord (see Fig. 2) is transmitted to the lever *M*, causing the end *Q* and therefore the rack *R* to rise upward. When

(*Concluded on page 452.*)

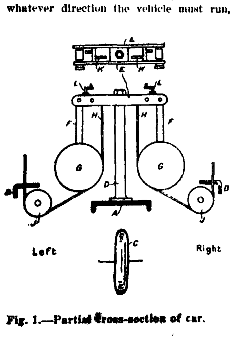


Fig. 1.—Partial cross-section of car.

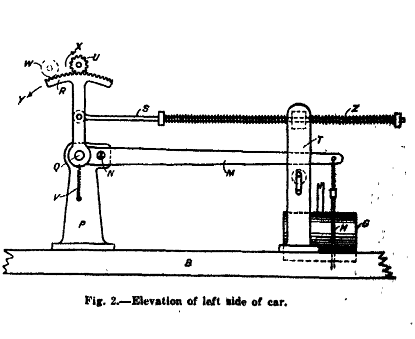


Fig. 2.—Elevation of left side of car.

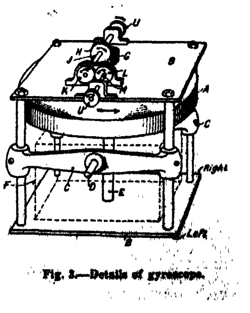


Fig. 3.—Details of gyroscope.

Training Wild Animals for Moving Pictures

By Robert H. Moulton

STRONG, ambitious wild animals, that until now have hoped for fame only in the circus or on the vaudeville stage, have found a new field for exercising their talent. A private dramatic school has been established near Fort Lee, New Jersey, which devotes its time exclusively to training beasts for the moving picture stage. Paul Bourgeois, a young French animal tamer, first thought of teaching the jungle inhabitants to appear before the camera, and he immediately founded the school of which he is still director.

This entire institution seems unusual to a regular patron of the "movies." A short distance out of Fort Lee one comes upon a low, one-story building, standing in the center of a small wood. A knock at the door brings M. Bourgeois himself, for he is gratified to show visitors through his unique educational establishment. The door leads almost directly into the studio. This apartment, where the pictures are made, is equipped with a stage, scenery, and skylight, all essential to the operation of any moving picture plant. The animals are kept caged in a large menagerie adjoining the studio, and are taken out only for the daily rehearsals. With a few slight exceptions, the principles of animal posing and human acting are the same. When a film requiring beasts is to be made, the animals are first trained regularly in their simple movements until the performance becomes a habit, since they can respond only to instinct, not to intelligence. Originality must be used by the trainers to make their charges do the right thing at exactly the proper time for the camera man. For this purpose common devices are coating tree branches with honey to keep Bruin aloft the entire length of a scene, or exposing a chicken off the stage when the fox should jump out of a window. The animals feel at home only in the studio of the school, and consequently, the company of human actors must go to Fort Lee when a film is made.

A marvelous circumstance of the profession, for which M. Bourgeois himself can hardly account, is that these so-called dangerous beasts rarely attempt to harm their fellow actors. In fact, no person has been injured by any animal in the New Jersey school. Women, maintains the director, seem even more fearless than men. To prove this assertion, M. Bourgeois describes the production of "Beasts of the Jungle," a popular film at present. In one scene a small, young actress with complete security nestled up close to Princess, a huge tigress, while several stage hands and moving picture employees, with less confidence, nervously held revolvers leveled at the animal.

An interrupted shave. A humerous scene from a wild animal moving picture film.

An Unattended Lighthouse

By H. J. Shepstone

ALTHOUGH every civilized nation possessing a coast line has now a number of automatic light buoys and even beacons, the only unattended lighthouse built on a wave-washed rock boasting of a powerful fog signal and all the apparatus associated with a fully equipped light station is the recently completed Platte Fougère tower, marking the entrance to Russell Channel, which leads to St. Peter's Port, the capital of the island of Guernsey, in the English Channel. The tower guards dangerous reefs which have for years been a menace to shipping, more particularly in foggy weather than at night. The tidal currents and the great rise and fall of the tide, with its swing of 30 feet at this spot, also makes navigation extremely difficult.

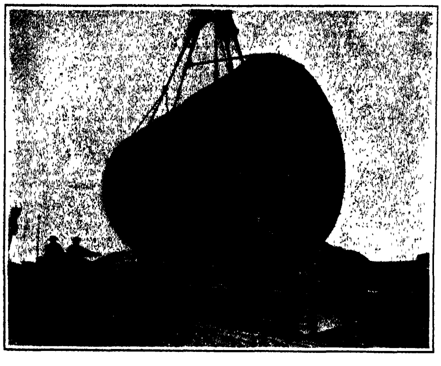
The possibility of erecting a stone tower to accommodate keepers was soon found to be out of the question, not only owing to the great cost that would be involved in constructing a rock lighthouse that men could live in, but also on account of the small area of the rocks. The difficulty was overcome by equipping one of the rocks with an 80-foot tower large enough to hold motors, compressors, fog horn and light, which are all controlled by a submarine cable from the shore. This lighthouse, with its wonderful array of electrical devices for warning and guiding the mariner through the dangerous channel, rises from a rock known as Platte Fougère, always submerged except at low water.

On the entrance level is a compartment containing an electric motor and air-compressor, while on the floor immediately above is a duplicate installation. The syren projects through the top of the tower, the trumpet being so turned as to throw the sounds in a horizontal direction over the water. On the top of the tower is a small automatic acetylene gas plant and lamp. All these devices, many of which are the invention of Mr. E. C. Catford, are controlled from the shore station, 1¼ miles distant, by means of a submarine cable specially made for this work. In fog it is desirable to know that both light and fog signal are working satisfactorily. Accordingly Mr Catford designed special alarms which would inform him of their behavior. At a distance of some 15 feet from the lantern he placed a selenium cell electrically connected with an alarm bell in the shore station So long as the light flashes every ten seconds on the cell the bell does not ring, but should fog obscure the light or the light go out for any reason, the bell at once commences to ring, thus giving the alarm. In the same way a bell rings in the engine room at every blast of the syren. The signal comes instantaneously, the actual sound of the blast itself reaching the shore five seconds later.

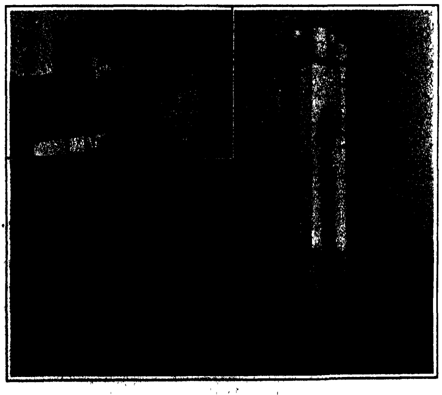
Another device is the telephone which has been installed in the tower for the use of pilots and others. It is the only ocean telephone call office in existence It is principally used by pilots to announce to the authorities the approach of mail boats during foggy weather. They simply climb the ladder of the tower and ring up the exchange.

The shore station is situated at a point known as Doyle Fort. Here a dwelling has been erected for the keepers, adjoining which is the engine house. The machinery includes two oil-engines which drive three-phase alternators, and an air-compressor for working the land syren should that be required. In the tower itself there is a simple switch operated by an electro-magnet, whereby motor-driven air-compressors are thrown in and out of action. Thus, at night the light can be automatically turned on, and at sunrise automatically extinguished. In the same way the fog signal can be set in motion or be discontinued at will.

The cost of the tower and its complete installation was $55,000, which may be considered a small figure when the exceptionally difficult nature of the situation is considered, as well as the powerful nature of the fog signal which has been erected, and the fact that an ordinary rock lighthouse establishment would have cost about $300,000. There is also the saving in maintenance, as only two keepers are required in place of four. Indeed, the Platte Fougère unattended lighthouse has solved a vexed problem how to warn mariners of the presence of dangerous rocks at a minimum of expense



One of the "Britannic's" twenty-nine, 105-ton boilers.



The unattended lighthouse at Platte Fougère in the English Channel. Motors, compressors, fog horn, and light are all controlled by a submarine cable leading to a shore station 1¼ miles distant.

The Boiler Plant of the "Britannic"

THE twenty-nine huge boilers of the 50,000-ton White Star liner "Britannic," now under construction at Belfast, were recently placed in position. Twenty-four of these are double-ended and five are single-ended, all being designed for a working pressure of 215 pounds, which has been found entirely practicable under natural draught conditions. Owing to the "Britannic's" great breadth it has been found possible to arrange five boilers abreast, except in No. 6 boiler room, where, because of the increased fineness of the hull, only four could be placed. All the double-ended boilers are 15 feet 9 inches in diameter, weigh 105 tons each, and are constructed of steel 1 11/16 inches thick. Each boiler has 159 furnaces of the Monson type.

The "Britannic's" boiler installation and the coal bunkers occupy six water-tight compartments, extending for a total length of 320 feet; the engine room takes up 123 feet additional of the 900 feet of length of the ship.

The "Brittanic's" engines, like those of "Olympic," will consist of a combination of two reciprocating engines in the wings, with a low-pressure turbine of the Parsons type placed amidships. The superior economy of this system is due to the fact that increased power is obtained, on the same consumption, by expanding the steam in the low-pressure turbine beyond the limits possible in reciprocating engines. This economy has been proved in the voyages of the White Star liners "Laurentic" and "Olympic"

Iron Ore, Pig-iron, and Steel Production

By Henry Harrison Suplee

DURING the year 1912, according to the report of the United States Geological Survey, the production of iron ore, and the resulting pig-iron and steel, showed a marked increase over the preceding year. The total quantity of iron ore mined amounted to 55,150,147 long tons, or slightly more than 25 per cent more than was mined in 1911, and the amount marketed was about 57 million tons, valued at 107 million dollars.

The amount of pig-iron manufactured during 1912, including the various ferro-alloys, such as spiegeleisen, ferromanganese, etc, was 29,726,937 long tons, which was again rather more than 25 per cent increase over 1911 The amount of pig iron marketed in 1912 was about 30 million tons, having a value at the furnaces of more than 420 million dollars.

Practically all of this iron, together with a small quantity of imported material, was manufactured into steel, the steel production of the United States during 1912 being a little more than 31 million tons, which, at the market price of $28 per ton for steel rails, gives a value of 868 million dollars

These figures show that 107 million dollars worth of iron ore is increased four times in value when converted into pig iron, and more than eight times when transformed into steel, an excellent example of the manner in which human effort adds to the value of natural resources

In order to give some idea of the volumes which these figures represent, we may take the iron ore as weighing 235 pounds per cubic foot, when 57 million tons would occupy a space of 543 million cubic feet, corresponding to a cube with edges 816 feet in length, or a cube higher than the Woolworth building in New York.

When reduced to pig iron, increasing in value four times, the volume becomes about 150 million cubic feet, corresponding to a cube 532 feet high, or nearly that of the Washington monument at the National Capital. The conversion into steel, doubling the value, and raising it from about 100 million to more than 800 million dollars, reduces the volume to about 145 million cubic feet, or a cube 525 feet high

These figures are better grasped by comparison with various large structures, and we may use the new terminal station of the Pennsylvania Railroad in New York. This covers an area of about 450 feet by 850 feet, or 382,500 square feet The iron ore mined in the United States in 1912 would cover this area to a height of 1,420 feet, or double the height of the Metropolitan tower in New York, while the pig-iron would require to be piled in a solid mass 400 feet high to include the production of the past year in America.

It is interesting to note that of the 31 million tons of steel made in the United States in 1912, only about one third was made by the Bessemer process, the remaining two thirds being open-hearth steel Until 1907 the preponderance was in favor of steel made by the Bessemer process, but in that year the open-hearth product equaled that of the Bessemer converter, and it has maintained a steady lead ever since. About 42 per cent of the iron manufactured was produced in Pennsylvania, and 23 per cent in Ohio. Illinois makes 9.7 per cent, while New York and Alabama were close rivals for the fourth place, New York being slightly in the lead

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More Power from the Rhine.- The amount of power taken from the Rhine for electrical purposes is already considerable, and this is now to be increased by new plants which are to be erected. Starting with the 15,000 horse-power of the Rheinfelden station, two new plants were then put up at Augst and Wyhlen, giving together 30,000 horse-power and distributing current over a large area. But the largest plant of all will be built upon the upper Rhine, and it will furnish no less than 60,000 horse-power, making use of the part of the stream lying between Albbruck and Schäffigen. The new plant is to have 10 turbines of 5,000 or 6,000 horse-power each, and three of the alternators of three-phase type coupled to the turbines will give 5,200 kilowatts, while the other three are rated at 6,150 kilowatts. Such alternators represent the most recent designs for this class of machine, and run at 107 revolutions per minute, working at 6,000 to 6,600 volts. Current will be sent over power lines at 47,000 and 78,000 volts by the use of step-up transformers in the station.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Latin-American View of the Problem of Our Navy

To the Editor of the SCIENTIFIC AMERICAN:

I am sorry to note that your valued articles dealing with "The Problem of Our Navy" have been brought to a conclusion.

The continuance of such articles is the only way to bring to the mind of the people of the United States that the Navy can be made practical; that it is a school for poor young men who lack educational opportunities; that it gives them a discipline second to none, and most of all, that the first-class policies of the United States, namely, Indivisibility of China, Asiatic Exclusion, the Monroe Doctrine, etc., can only be enforced by a large and strong navy.

This Monroe Doctrine, which has kept many a Latin-American republic from the jealous eye of the European powers, can only be maintained by a navy large and strong enough to make war with the United States a difficult task for these European powers, being as they are, 3,800 miles away from their main naval bases, but with a great preponderance of capital ships—dreadnought type—this task could be accomplished by such powers.

All this you and the Secretary of the Navy have explained wonderfully well in your several articles.

If you were to ask all the more educated class of Latin-Americans what is the object of the great naval programme which Germany has started a decade ago, the answer would correspond with yours: The Monroe Doctrine, the Panama Canal, and her great commercial interests with Central and South America.

I am positive that the better class of Cubans and Latin-Americans are more interested in the increase and efficiency of your Navy than the average inland citizen of the United States. Your Navy is the only friend that we Latin-Americans have that can keep the greedy hands of the nations of the Old World away from us, and dropping fast as she is to a fourth-class navy (not to a third-class as you say), we stand helpless at their hands in the event they should attempt conquest.

I noted in your recent articles that you often spoke of a first-class navy, that of England with forty-two dreadnoughts built and building; a second-class navy, that of Germany with twenty-six dreadnoughts built and building; and a third-class navy, that of the United States, with thirteen dreadnoughts built and building, with France and Japan close behind with eleven and ten of these ships, respectively. Permit me to say that you have not done justice to France. Perhaps it was an oversight on your part. The modern French navy will be, I am sorry to say, superior to that of the United States. I shall make here a *rough comparison* of capital ships built, building, and authorized by both nations:

United States Ships.

	Tons	Main battery.
2 "Michigans"	32,000	16 12-in. guns
2 "Delawares"	40,000	20 " "
2 "Floridas"	43,650	20 " "
2 "Arkansas"	52,000	24 " "
2 "New Yorks"	54,000	20 14-in. "
2 "Oklahomas"	55,000	20 " "
2 "Pennsylvanias"	62,000	24 " "
Total tonnage	338,000	

French Ships.

	Tons.	Main battery.
4 "Jean-Barts"	94,000	48 12-in. guns
3 "Bretagnes"	70,500	30 13.4-in. "
4 "Normandies"	101,548	48 " "
4 (New ones)	116,000	64 " "
Total tonnage	382,048	

Assuming the weight of the 12-inch projectile of the United States and French navies to be 870 pounds; the weight of the 14-inch American projectile to be 1,400 pounds; and the weight of the 13.4-inch French projectile to be 1,433 pounds, in comparing gun power, we see that a single discharge of all the big guns of the 15 dreadnoughts of the French navy would throw a shower of deadly material weighing 245,246 pounds on a target of fourteen American ships, as against a discharge of 159,200 pounds of metal of one single round fired from all the big guns of the fourteen dreadnoughts of the American Navy, on a target of fifteen French ships. This shows a superiority of the French ships of 54 per cent in gun power, regardless of the fact that the projectile of the 13.4-inch gun of the French navy, although of less diameter, has a greater muzzle velocity, and being heavier, is considerably more powerful than the 14-inch American gun. Of these large guns the American ships are equipped with sixty-four, as against one hundred and forty-two on the French ships. It must be borne in mind also that the two "Michigans" have less speed, and that the two "Michigans" and two "Delawares" are not as heavily armored as the four smaller French ships of the "Jean-Bart" type; namely, the "Jean-Bart," "Courbet," "Paris," and "France."

The United States, therefore, stands now as a fourth-class naval power in modern ships. In this *rough comparison* of gun power and tonnage, I have not included the battleships of the pre-dreadnought type, of which the United States has a great superiority, but no nation that looks forward to a first-class line of fighting ships would look upon them for reliance in future naval battles.

My only aim in bringing this comparison to your mind is to show you that as the matter now stands, the United States is dropping as a naval power at a higher rate than it is generally believed in your country, and which is looked at with regret.

Are many Americans also aware of the fact that the Italian government has eight dreadnoughts built and building, and is now considering the construction of four 35,000-ton ships, each carrying twelve 15-inch guns in four triple turrets, the projectile of which guns weighs 1,650 pounds; that the Spanish government has just voted a credit of $324,000,000 for the construction of dreadnoughts, scout cruisers, destroyers, etc.?

I, therefore, encourage you, Mr. Editor, to have this subject of the Navy on your publication every now and then, until you have convinced your people and your country of the necessity to build and keep a *second-class navy*, such as you had in 1906, to maintain peace, not to make war.

Please accept my heartiest thanks for your valued literature, and that of the Hon. Josephus Daniels, Secretary of the Navy, dealing with the subject mentioned above, which is of vital importance to your country, and to all America.

Since I am a foreigner, I must ask your pardon for my poor English. IGNACIO VALDÉS.

Hormiguero, Cuba.

The Tide-predicting Machine

To the Editor of the SCIENTIFIC AMERICAN:

Please grant me space in your journal to make the following statements in reference to a note in your issue of May 2nd, 1914, page 362, headed "The Tide Predicting Machine" and signed by R. A. Harris:

I do not wish to make reply to or discuss the contents of that note. But, in order to prevent silence being interpreted as acceptance of the position assigned me therein, I beg to state:

The C. and G. S. Tide Predicting Machine No. 2 is one of the products of the Coast and Geodetic Survey. The officials of that Bureau are thoroughly familiar with its development from its first inception, prior to 1890 (the year in which Dr. Harris entered the service), to its final completion. They accorded the undersigned the honor to publish a description, under his name, in *Engineering News*, issue of July 20th, 1911, and in the *Journal of the Washington Academy of Sciences*, issue of July 19th, 1911.

The various statements in Mr. C. H. Claudy's article in your issue of March 7th, 1914, are substantially correct, though his references to the undersigned are unduly laudatory. E. G. FISCHER.

Washington, D. C.

The Current Supplement

OUR SUPPLEMENT, No. 2004, brings an illustrated description of the Westinghouse marine turbine.—Dr. F. A. Woods contributes a study on the racial origin of successful Americans.—Prof. G. G. Scott writes on the relation of aquatic animals to the surrounding water.—L. B. Ward gives an account of this year's additions in the United States Navy.—M. v. Jakubowski describes the mining and other methods of obtaining amber on the Baltic coast.—J. J. Smith discusses the power required for refrigeration.—J. H. B. Bryan describes the building of large gas engine flywheels.—In an article on the stability of ships' lifeboats the decked type of boat is recommended, the common type affording little protection even in a fairly good sea.

The Forthcoming Trials of Langley's Machine

LANGLEY'S full-sized aeroplane, on which the United States Government spent more than $50,000, was brought to Hammondsport six weeks ago. In the next number of the SCIENTIFIC AMERICAN we expect to publish a complete illustrated account of these trials from the pen of a special correspondent at Hammondsport.

Our Navy and the Mexican Situation

IN the first of our series of articles on "The Problem of Our Navy," written by the Assistant Secretary of the Navy, the Hon. Franklin D. Roosevelt, we published a map showing the disposition of the ships of the United States Navy on February 12th of this year. This map served to illustrate the fact, which was brought out b~ Mr. Roosevelt in his article, that not only in the stress of wartime, but also in days of peace is our Navy very actively employed. On the day named, there were stationed on the Gulf and Pacific coasts of Mexico, at its various ports, some fourteen or fifteen United States war vessels.

Since the date of that article, the Mexican crisis has become so acute and events have moved so swiftly that, to-day, there are gathered at the various Mexican ports no less than eighty-three ships, in which is included the very flower of our Navy. In this fleet are included eight dreadnoughts, ten pre-dreadnoughts, four armored cruisers, one modern monitor, our three fast scouts, four protected cruisers, twenty-three of our latest destroyers, four gunboats, four third-class cruisers, seven colliers (these the largest and fastest of their class to be found in any navy of the world), one mining ship, two auxiliary cruisers, four large seagoing tugs, one refrigerating ship and six miscellaneous vessels of the auxiliary type.

The events which have led to this great naval demonstration are so well known as to call for no recapitulation here; but we do wish to emphasise the fact, that, when the President, realising that matters between the United States and Mexico had reached that critical line where diplomacy gives way to naval and military force, called for the dispatch of the Atlantic fleet to Vera Crus for the seizure of that port, the Navy was prepared to make a quick response. The Atlantic fleet concentrated on Vera Crus with highly commendable rapidity; the seamen and marines were landed; and before many hours had elapsed, the port was in our possession and the work of disarming the populace, seizing the water-works, and throwing out around the city a cordon of outposts was under way. The work was done with a neatness and dispatch which proved that, for work of this character, our Navy is in a condition of very high efficiency.

The seamen and marines, some six thousand of them, received their baptism of fire under difficult and very disconcerting conditions, the enemy being concealed, for the most part, within houses, or protected by the high parapets of the roofs. Nevertheless, the accounts agree that these young men went through the ordeal with all the steadiness of veteran forces. The severity of the fighting is shown by the fact that on our side alone some twenty lives were lost, and about three times that number were wounded. The Mexicans are estimated to have lost some 200 men.

Following immediately upon the occupation, Admiral Fletcher put in hand the work of restoring order and confidence, with the result that Vera Cruz quickly settled down to its routine of daily life—and this under conditions of security which it had never known in all the centuries of its existence.

We have received a personal letter from the captain of one of our ships, which pays such interesting tribute to the work of the Navy down there, that we venture to publish the following excerpt:

"I have just returned aboard after commanding one of the regiments of bluejackets. The embarkation of the 6,000 sailors and marines was astounding. We passed in review before the Army and Advance Base Marines, and went aboard tugs and steamers. In 35 minutes from the signal to begin moving, the force was clear of the dock and bound back to the ships.

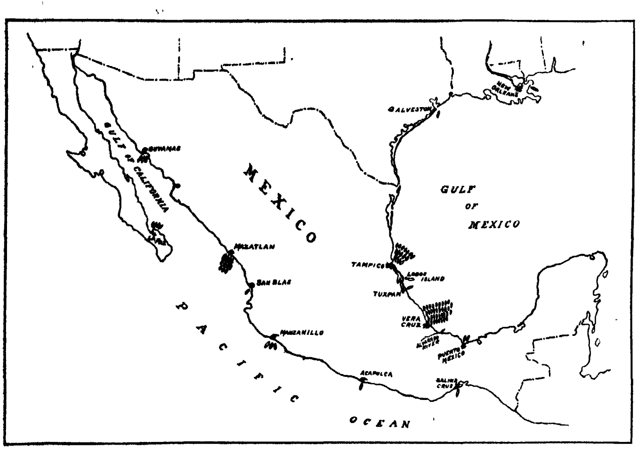
"The Supply Department was beautifully handled by our paymasters and marine officers. The cooking was excellent—meals served promptly—although everything was improvised out of very little in the way of stores and means of cooking. It was a triumph for our Commissary System.

"Our men behaved *absolutely*. We cleaned the city of all firearms, weapons, and ammunition; and we cleaned the streets. What New York, Washington, and Philadelphia need is an effective street-cleaning department such as we put into Vera Cruz, something which our city governments seem to be powerless to organize and keep in *successful* operation."

This fine tribute is in line with Admiral Fletcher's modest praise of the marines and bluejackets, when he said: "In nine days' work Vera Cruz was occupied by the Navy, lawlessness and disorder suppressed, 11,000 firearms taken possession of, and a line of defenses established around the city against an army threatening to recapture it. Business was resumed and normal conditions restored."

Later Gen. Funston reached Vera Cruz with a force of 4,000 men of the Regular Army, which, at the present writing, is in occupation of the city.

For the next few weeks, the center of interest will be found at the Niagara Peace Conference.



Map showing location of the ships of our Navy at Mexican ports on May 20th, 1914.

The Wreck of the Forlanini Airship "Citta di Milano"

FROM the London *Engineer* we glean some details of the disaster which befell the Forlanini airship "Citta di Milano," on April 9th. The disaster is to be attributed not to any defect in design but to the stupidity of the populace among whom the craft was forced to descend. In order to repair a leaky valve, the airship was brought to the ground after she had left her shed, and moored to some trees with ropes partly of hemp and partly of steel, having a breaking strength of five tons. Before the necessary repairs could be made to the valve, the ropes gave way and the ariship was driven for about 170 yards against some mulberry trees. She was again moored, and the commanding officer decided to deflate the bag. A crowd of peasants gathered to watch the operations. The soldiers could not drive them back. Indeed, they could not be even made to give up smoking. As the deflated bag fell over toward the crowd on the left side, several explosions followed hard on one another. A great blast of blue flame shot out from the airship, and passing away left behind nothing but a twisted mass of framework and a struggling body of human beings. About eighty people were more or less seriously injured. Thus through the crass obstinacy of a few yokels a vessel presented to the government by public subscription at a cost of $80,000 was destroyed beyond repair. The airship had had a life of nine months, had made many successful voyages, and like her fore-runner, the "Leonardo da Vinci," had been singularly free from accident.

The Iron Smelter's Fuel Bill

By Henry Harrison Suplee

FEW people realize the magnitude and importance of what may be termed a secondary industry in the United States—the manufacture of coke. The removal of injurious substances, with respect to metallurgical purposes, by driving off the sulphur and other volatile constituents from coal by the operation of coking, forms one of the important elements in the iron industry, since by far the greater portion of the coke made is intended as fuel for blast furnaces used in the smelting of iron ore.

In the year 1912 the quantity of coke made in the United States was 43,983,599 short tons, according to the report of the United States Geological Survey, or in round numbers, about 44 million tons. This corresponds to more than 3,000 million cubic feet, and would fill a cube of 1,442 feet length on each edge, or twice the height of the Metropolitan tower in New York.

The coal from which this coke was made, 65,577,862 tons, would fill 1,311,500 cars of 50 tons capacity, making, if coupled up in one train, a length of 8,700 miles, extending from New York to San Francisco and all the way across the Pacific Ocean.

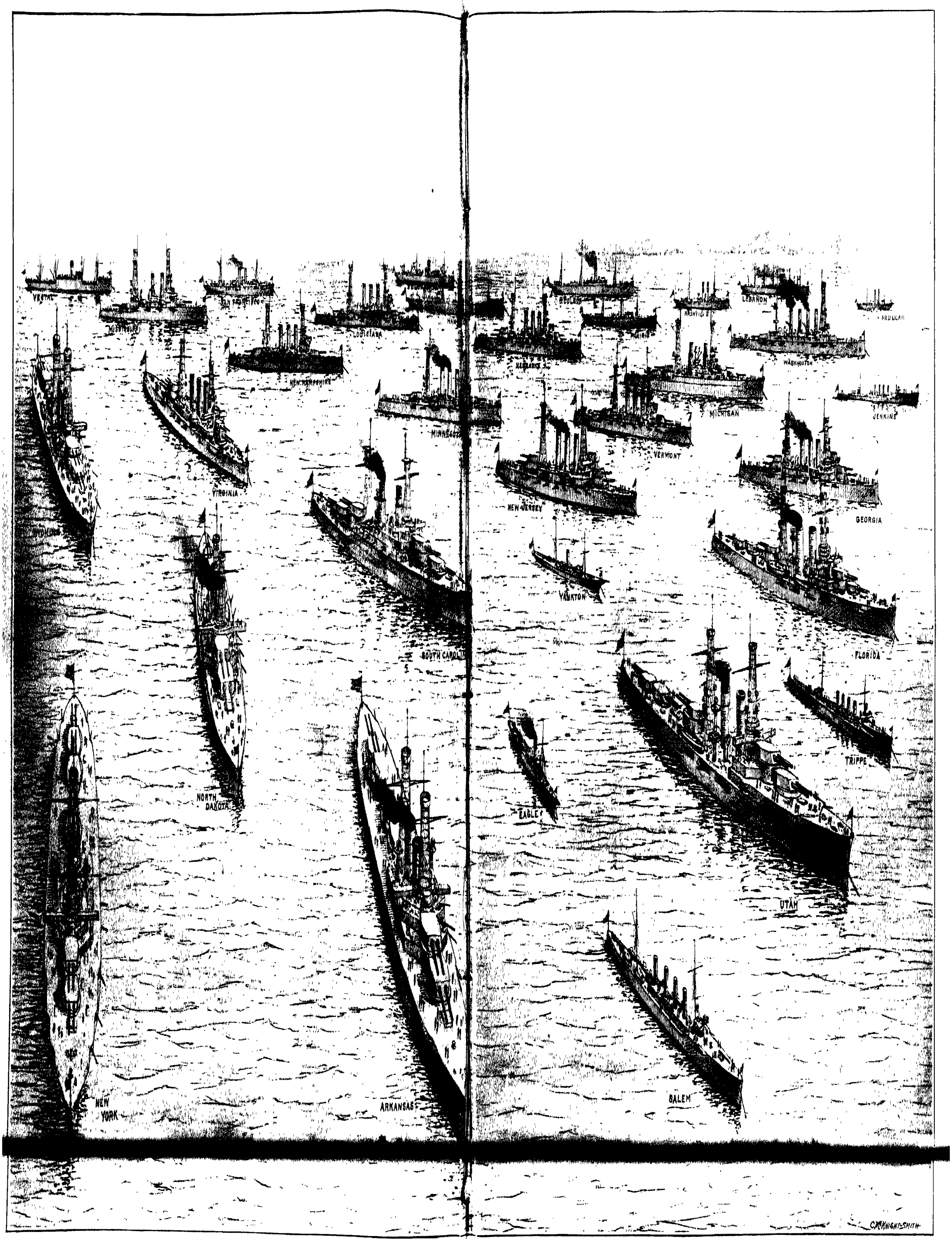
This coal is valued at about 87 million dollars, while the coke made from it was sold for more than 111 million dollars, an increase in value of more than 27 per cent. Less than four years' production of this amount of coke would equal in value the entire cost of the Panama Canal, including sanitation and the purchase price to the French company.

During the year 1912 there was a notable increase in the proportion of coke made in by-product ovens. Formerly all the coke made in America was made in the inefficient beehive oven, all the gas and ammonia going to waste. Last year, one fourth of the entire quantity was made in by-product ovens, the coal being coked in retorts, which enabled these valuable products to be saved, a portion of the gas being burned as fuel for the coking, and a large amount being sold for other purposes. At the present time about fifty million cubic feet of illuminating gas per day is produced as a by-product of coke ovens, supplying such cities as Boston, Indianapolis, Baltimore, and Milwaukee.

From the eleven million tons of by-product coke made in the United States, there was derived sixteen million dollars value of by-products consisting of gas, tar, and ammonia. Since the coke itself had a value of forty-two million dollars, there was added 38 per cent value to the product by the recovery of valuable products formerly thrown away. If efficiency is rightly defined as reduction of waste, there is here a most notable example of modern efficiency. A similar gain, applied to the coke made in the wasteful beehive ovens, would represent more than twenty-five million dollars, without taking into account the greater value in the improved quality of the coke itself. In this connection attention may be called to the emphasis laid by Dr. Diesel upon the efficiency attainable by using gas tar as a fuel for Diesel engines. He maintained that if all coal was refined by coking, the power developed from the gas and the tar would equal that which could be derived by burning all the coal under boilers, while the coke would remain available for metallurgical purposes and such uses as would still require solid fuel.

The South Magnetic Pole

A JOURNEY to the region of the south magnetic pole was made by Lieutenant Bage and Messrs. Webb and Hurley, of the Mawson expedition. Observing stations were established every 10 miles along the journey of 300 miles from Winter quarters, in spite of the extremely rigorous climatic conditions. The readings showed strong local variations in magnetic force, but on an average the dip of the magnetic needle increased about one minute of arc for every 3 miles. From the observations it appears that in December, 1912, the approximate position of the northwestern edge of the magnetic polar area was in latitude 70 degrees 36 minutes S., longitude 148 degrees 12 minutes E. This differs by over 100 miles from the position of the southeastern boundary of the area, as determined by David and Mawson in January, 1909, during the Shackleton expedition. Webb provisionally estimates the width of the area in a SW-NE direction to be about 40 miles. If this estimate is correct, and if the positions were accurately determined in 1909, the polar area must have shifted materially since that time.



BIRD'S EYE VIEW OF THE FLEET OF UNITED STATES SHIPS ASSEMBLED AT VERA CRUZ, ON MAY 20TH, 1914,

The Heavens in June

New Comet Discovered—Counting the Stars

By Henry Norris Russell, Ph.D.

THE second comet to be discovered in 1914 was found by Zlatinsky, at Meitau, Russia, on May 16th, in the northern part of Perseus, almost due north from the Sun. It was unusually bright for a newly discovered comet, being visible to the naked eye, according to the first report, and in an opera glass, according to the next day's telegram. Only the first two days' observations are at hand when this must be written; but they suffice to tell a good deal about the comet.

On the 16th of May it was in 3 hours 18 minutes right ascension and 49 degrees 51 minutes north declination, within a fraction of a degree of the bright star Alpha Persei. The next night it had moved westward by nearly 21 minutes of right ascension, which (in this declination) amounts to about 3 1/3 degrees in the sky, while it had gone northward by but 7 minutes of arc.

Its apparent direction of motion is straight toward Capella, and its rate such that, if moving uniformly, it would reach the neighborhood of the latter star in about six days. At present it is equally well, or ill, to be seen in the evening or morning sky, being some 10 or 15 degrees high in the northwest when the sky grows dark, grazing the northern horizon at midnight, and coming up in the northeast before dawn. For observatories in northern Europe it is circumpolar, and 10 degrees or more high at midnight, so that they have a far better chance of observing it than we have. But in a week or so it will be much higher in the evening sky, and there should be no trouble in observing it.

Nothing can yet be said concerning its orbit, though the facts will be known within another week. But from its rapid apparent motion it can easily be shown that it must be within 75 million miles of the Earth, and not less than 45 millions from the Sun, and also that its motion must be in the opposite direction from that of the Earth.

It may be much nearer to us than the limit just mentioned: but this must remain uncertain until detailed calculations are made. The circumstances are unfortunately such that it is still impossible to say, even roughly, where the comet will be in the sky by the first of June, or even whether it will be brighter or fainter then than at the time of discovery.

Kritzinger's comet has been favorably placed for observation during the present month, and will be almost as well in June. On the 2nd of June its predicted position is in right ascension 20 hours 54 minutes, declination 41 degrees 30 minutes north—about 5 degrees southeast of Alpha Cygni. It is then moving eastward and a little northward, at a little less than 1 degree a day. By a rough extension of the published ephemeris, it appears that on the 16th it should be approximately in 21 hours 48 minutes plus 44 degrees 35 minutes, and on the 30th in 22 hours 30 minutes plus 46 degrees. Its brightness will even then be about two and one half times that at the time of discovery, but as it was then described as fainter than the ninth magnitude, it will not, even at best, be a conspicuous object in a small telescope.

Delavan's comet is slowly coming out into the morning sky, but is not observable yet. Its position on June 18th is given as 4 hours 28 minutes plus 26 degrees 12 minutes, which would make it rise 1 hour and 20 minutes before the Sun. It will be observable once more in July, but will not become conspicuous till later in the year.

It has been customary to comment here upon the astronomical literature of the past month; and for mention this time we may well take one of the numerous pieces of good work which are now coming from the University of Lund, in southern Sweden, where Prof. Charlier has gathered around him a group of able students.

Fortunately for astronomers in most countries, these publications, though bearing the title, "Meddelanden fran Lunds Astronomiska Observatorium," are written sometimes in German, but often in excellent English, as is the case with the work under consideration by Dr. Hans Henie.

Dr Henie has set himself the problem of determining the number of stars in the sky brighter than the eleventh magnitude, and the density with which they are distributed, per square degree, in the various parts of the heavens.

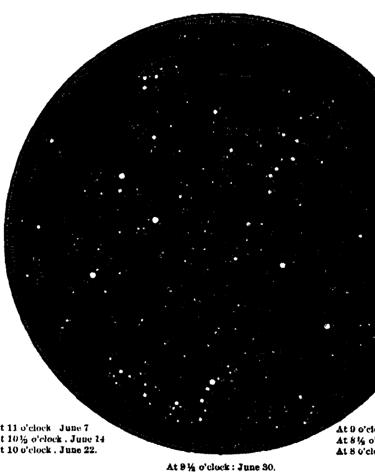
As material for his investigation, he employed the well known "Harvard Sky," a series of fifty-five plates, taken at Harvard and Arequipa, Peru (which among them cover the whole heavens from pole to pole), of which duplicates have been furnished to many observatories.

The first thing to do was to count the number of star-images shown on these plates. Dr. Henie ingenuously remarks: "As the number of stars was about one and one half millions, I refrained from counting them all." Instead of this, he mapped out a series of one hundred squares, one centimeter on a side, distributed evenly over each plate, and covering about one quarter of its area, and counted the stars in these squares. The average number of stars per square was 78, and the whole number of stars counted no less than 425,497. In one region in the Southern Cross, nearly 2,000 stars were counted in a single square.

The next problem was to find out how faint were the faintest stars shown on each plate. This was made relatively easy by the fact that, in the regions of the sky surrounding a large number of variable stars, the brightness of a sequence of faint stars has been measured. By identifying these stars on the plates, the magnitude of the faintest stars visible could at once be determined. But this was not the whole story, for it was found that much fainter stars were shown near the center of each plate than at its edges, and corrections had to be made for this, which was successfully accomplished by a very ingenious method. After this has been done, the number of stars in each region which are brighter than the eleventh magnitude can be calculated. Dr. Henie finally concludes that the whole number of stars in the sky above the eleventh magnitude is 1,013,328, or an average of not quite 25 per square degree, which is equivalent to a little more than five such stars in an average bit of sky as big as the full Moon. But the number of stars per square degree varies enormously in different parts of the sky. The regions poorest in stars are in Ursa Major, in about 9 hours plus 50 degrees, and again in about 13 hours 30 minutes plus 57 degrees, in each of which there are less than five stars per square degree brighter than the eleventh magnitude. The whole region occupied by the Great Dipper (which lies between the two positions just mentioned) is very poor in telescopic stars.

The richest regions are in Ophiuchus in 18 hours 20 minutes plus 2 degrees, where there are actually 112 stars per square degree above the assigned limit of magnitude, and in Cygnus (21 hours 8 minutes plus 52 degrees) with 105 stars per square degree. Regions almost as rich are found in Sagittarius (17 hours 40 minutes minus 27 degrees) and Argo (9 hours 40 minutes minus 62 degrees). All these rich regions lie in the Milky Way, while the poor ones are near its pole. The average number of stars per square degree in the Milky Way is more than forty, while near its northern pole it is about seven. Near the southern galactic pole, curiously enough, the number of stars per square degree is about twice as great.

There is little doubt that if similar counts could be extended to still fainter stars, the increase of their numbers toward the Milky Way would be still more marked.



At 11 o'clock June 7
At 10½ o'clock . June 14
At 10 o'clock . June 22.

At 9 o'clock July 7.
At 8½ o'clock : July 14.
At 8 o'clock . July 22.

At 9½ o'clock : June 30.

NIGHT SKY: JUNE AND JULY.

The Heavens.

The rich regions of the Milky Way, of which we have just been speaking, are now conspicuous in the eastern and southeastern sky, though the vast agglomerations of still fainter stars which form the great clouds extending from Aquila to Scorpio are even more prominent. Among the brighter stars, too, many of the finest groups will be found in this region; Cassiopeia, low in the northeast; Cygnus and Lyra, a little north of east; Aquila, farther to the southward; and then Sagittarius and Scorpio, the latter extending to the meridian. Ursa Minor and Draco are in the north, above the pole. Hercules and Corona are right overhead, with Ophiuchus and Serpens to the southward. Arcturus shines splendid, high in the southeast, and Spica, apparently fainter, but far more remote, and really brighter, appears below. Leo is low in the west, and Ursa Major well down in the northwest, and sinking steadily.

The Planets.

Mercury is an evening star all through June, and is well observable in the earlier half of the month, setting at about 8:45 P. M. on the 1st and 9:10 on the 18th, when he is at his greatest apparent distance from the Sun. After this he moves southward, and becomes less easy to see; setting about 8:30 at the end of the month. On the 1st he is brighter than Arcturus; but as his crescent narrows he grows fainter, and by the end of the month he is fainter than Regulus.

Venus is likewise an evening star, setting about 9:30 all through the month, and is very conspicuous.

Mars, too, is visible in the evening, but is higher in the sky, setting about 11 P. M. on the 15th. He has fallen off very much in brightness, and is now no brighter than the brightest stars of the Great Dipper.

Jupiter is still a morning star, but is growing more conspicuous. He is in the eastern part of Capricornus, and rises near midnight on the 1st, and a little before 10 P. M. on the 30th.

Saturn is in conjunction with the Sun on the 13th, and cannot be seen this month.

Uranus is in the middle of Capricornus, and rises about 10:15 P. M. in the middle of the month. Neptune is in Gemini, and sets at about 9:30 P. M. on the same date.

The Moon is in her first quarter at 9 A. M. on the 1st, full at midnight on the 7th, in her last quarter at 9 A. M. on the 15th, new at 11 A. M. on the 23rd, and returns to her first quarter at 2 P. M. on the 30th. She is nearest us on the 5th, and farthest away on the 17th.

While traveling around the skies, she passes near Uranus on the 11th, Jupiter on the 12th, Saturn on the 22nd, Mercury and Neptune on the 25th, Venus on the 26th, and Mars on the 27th.

At 2 A. M. on the 22nd, the Sun attains his greatest northern declination, 23 degrees 27 minutes 10 seconds, and enters the "sign" of Cancer, which, being an imaginary region of the ecliptic and affected by precession, has during the last 2,000 years backed into the constellation Gemini, and, as the almanacs will have it, "Summer commences."

Princeton University Observatory.

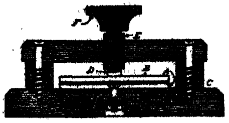
Guinea Pigs were imported into this country for laboratory experiments during the year ended June 30th, 1913, to the number of 12,112, as compared with only 1,471 the year before.

A Variable Condenser

By Frederick E. Ward

IN constructing his own wireless receiving apparatus, the average amateur probably encounters his greatest difficulty in making a good variable condenser, because the commercial form of this instrument, consisting of a system of fixed and of movable vanes, requires that a large number of parts be made and assembled with considerable care.

To overcome these difficulties the author has developed the simple form of condenser shown in section in the accompanying drawing, where *A* and *B* represent the condenser plates, which are two brass disks about 3/32 inch thick and 2 inches in diameter. The first of these plates is fixed to the frame *C*, of wood or of other suitable insulating material, by a machine screw and nut which also serves as a binding post. The other plate is attached to the screw *D*, passing through the nut *E*, and carrying at its upper end the insulating knob *F*, by the turning of which the top plate is adjusted up or down, thus taking advantage of the law that, other things remaining constant, the capacity of a condenser is inversely proportional to the distance between its plates.



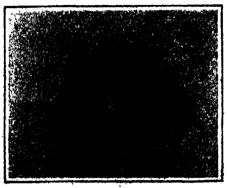
Constructional details of the condenser.

In making the simple form of variable condenser just described, it should be borne in mind that the best results are to be obtained by the use of a screw of fine pitch and of large diameter, such as is used in the well-known micrometer caliper. Not less than forty threads per inch, with a diameter of ¼ inch, is recommended. Care should be taken that the nut and screw are a reasonably good fit, and that the upper disk be turned off in the lathe so that its face will be truly at right angles to the axis of the screw. The lower disk should be leveled up by shims of tissue paper, if necessary, so that the two disks meet squarely when screwed together.

When the condenser is to be used in series with a large receiving aerial, for shortening its natural wave-length, it is of advantage to have nothing between the disks but air, for then they can, on occasion, be conveniently screwed together and short-circuited. If, however, *the condenser is to* be used in parallel with receiving instruments, where a short-circuit would be undesirable, this mishap may be guarded against by laying between the disks a slightly larger disk made from a film of clear, white mica one thousandth of an inch thick. This mica film has the effect of multiplying the maximum capacity of the condenser by a factor of about six.

In the photograph is shown a well-made instrument of the type just described. This one has a top piece of brass supported by four hard rubber posts, through which pass the four machine screws by means of which it is fastened to the base. The adjusting screw is provided with a graduated thimble so that the distance between the plates can be read off as with a micrometer, this serving as a scale. The knob could just as well have been provided with a hand or pointer moving over a scale marked on the top plate.

Such an instrument is suitable for use in a wavemeter of the Doenitz type, for which purpose it has a slight advantage over the usual form of condenser in that its capacity increases rapidly toward the end of the scale where the plates come together, while in the *ordinary form* the capacity varies uniformly along the scale. Since it is desirable to calibrate the scale directly in wave lengths, which are proportional to the square roots of the capacities, the disk type condenser, therefore, gives more nearly uniform scale divisions.



Home-made variable condenser.

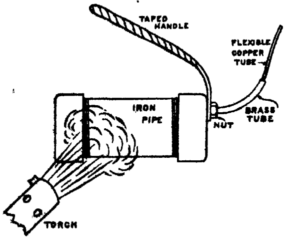
The maximum capacity of the average commercial type of variable condenser is about 0.003 microfarad. The calculated capacity of a pair of 2-inch circular plates spaced one thousandth of an inch apart in air is only about 0.0007 microfarad, but this value is increased to about 0.0045 microfarad by the introduction of a mica film, as recommended. In either case unscrewing the plates until they are 0.01 inch apart reduces the capacity to about 0.00007 microfarad. It will be seen from these figures that 2-inch disks are large enough to serve a useful purpose in many cases, though larger plates may often be employed to advantage.

Construction of an Oxygen Carbon Remover

AN oxygen generator for removing the accumulation of carbon from the combustion chamber and the piston of an internal combustion engine may be constructed as follows:

Take a short length of wrought iron pipe 1¼ inches in diameter, and thread and cap it at either end. Through one cap drill and tap a hole to receive a length of brass tubing. Solder a suitable length of annealed copper tubing into the end of the brass pipe. A handle may be provided by fitting in position a piece of ¼-inch strap iron, drilled for the passage of the brass tubing, and securing it with a nut as is shown by the sketch. The handle should be taped.

To use the device, a couple of ounces of chlorate of potash, to which has been added a teaspoonful of manganese dioxide, the two being thoroughly incorporated, are introduced into the chamber formed by the pipe, the rear cap being removed for the purpose. After the cap has been screwed tightly in place again, the chamber is heated with a blow torch and the end of the flexible copper tubing is introduced into the combustion chamber of the motor. As soon as the ingredients are sufficiently heated, oxygen is given off and the heat should be kept constant to insure a steady flow. In the presence of the oxygen, the caked carbon can easily be ignited and will burn from the surfaces in a minimum of time. Care should be taken not to apply too much heat. For cleaning multiple cylinder motors, the quantities of chemicals can be increased. Since the manganese dioxide acts merely to stimulate the decomposition of the potassium salt, it is evident that the proportions are not all important. Both chemicals can be obtained from any chemist in *small quantities, and at low cost.* Care should be exercised to keep foreign substances from contact with the chlorate of potash.



Oxygen generator for removing carbon from pistons and cylinder.

Dangers of Aviation.—In an interesting volume by Roger Depaginat on the martyrs of aviation, some interesting statistics are given showing the progress accomplished from 1908 to 1912. The total number of aviators for each year is given, together with the total distances traversed in the air. The price paid in lives for these triumphs is also given.

Year.	Aviators.	Miles Traversed	Killed
1908	5	1,500	1
1909	50	40,000	3
1910	500	920,000	29
1911	1,500	3,000,000	78
1912	5,800	17,000,000	140

Another table is attached showing the advance made per life lost.

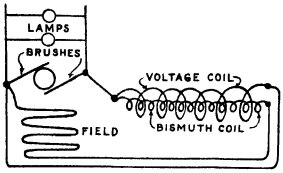
1908 one killed for 1,500 miles of flight.
1909 one killed for 14,000 miles of flight.
1910 one killed for 32,000 miles of flight.
1911 one killed for 40,000 miles of flight.
1912 one killed for 120,000 miles of flight.

Thus, from 1908 to 1912, the number of fatal accidents has proportionally diminished from 100 to 1, if one considers distances traversed, and from 10 to 1, if one considers the number of aviators flying. At this rate aviation will soon be less dangerous than automobiling.

Automatic Voltage Regulator

By J. Naveman

THE writer recently installed a shunt-wound dynamo on a motor car to supply current for lighting purposes, the drive of the motor being taken directly off the cooling fan pulley. However, the regulation of the output at the varying speeds offered a serious problem.



Automatic voltage regulator.

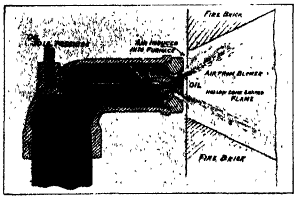
The resistance of bismuth increases when it is placed in a magnetic field, and the amount of increase varies directly as the strength of the field, within certain limits. Forearmed with this knowledge, the regulator shown by the accompanying sketch was constructed. A coil of bismuth wire was placed in series with the field of the dynamo, and the bismuth coil was made the core of a voltage coil which was connected across the lamp circuit. Under these conditions, the bismuth was subjected to the fluctuations of the voltage as indicated by the varying strength of the magnetic field of the voltage coil, and the resistance of the bismuth varied accordingly. When the voltage rose, due to increased speed, the field strength and resistance increased in proportion, cutting down the strength of the field circuit.

The chief difficulty lay in forming the bismuth coil, since that metal is too brittle to be drawn to a filament. It was solved by embedding a long, loosely coiled steel spring, previously oiled, in plaster of Paris, and, after the material had set, unscrewing the spring from the plaster. The bismuth, molten of course, was forced into this mold with the aid of a dentist's vacuum casting machine. When the plaster was carefully broken away, a perfect coil of the desired metal was left.

Low-pressure Atomizing Burner

OIL burners using high-pressure air or steam have been predominant ever since oil has been used as a fuel, owing to the difficulty of atomizing the oil with low-pressure. The typical low-pressure burner merely projects into the furnace a core of oil surrounded by a column of air, which on striking an abutment in the furnace causes an admixture of the oil and air.

The atomizer here illustrated embodies some radical improvements designed to convert the oil into a fog or mist. It comprises an inner nozzle through which the oil is delivered from under a high pressure. The passage-way in this nozzle is terminated, at the delivery end, by a small orifice, and within this passage there is placed a spiral. The oil is guided around this spiral, effecting a violently whirling jet in the orifice, which action causes it, upon delivery, to spread out in a cone-shaped film. Surrounding this nozzle is a casing, inclosing a large spiral, through which the air (or steam) must pass, so that the air, too, is delivered from the final restricted discharge orifice in a whirling current, which action likewise causes the air to assume the form of a hollow cone-shaped film. The oil film is drawn into the whirling current of air, and, being the heavier fluid, the centrifugal force throws it toward the outer edge of the air film. The air from the blower therefore penetrates the mechanically atomized film of oil and reduces it to a fog. This action results from blower air of under 8 ounces pressure, giving a high degree of atomization at low cost and a mixture which affords perfect combustion without an excess of air.



Low-pressure atomizing burner.

The Motor-driven Commercial Vehicle

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The Editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles.

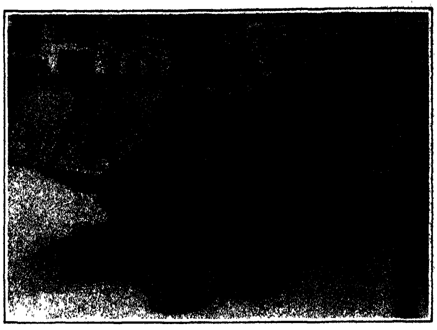
Dumping Truck for Ash Removal

By Ross Babcock, M.E.

THE removal of accumulations of ashes and other refuse always has constituted more or less of a problem in large cities. Now, however, the municipal authorities of Greater New York would seem to have solved the problem in an effective manner. There just has been placed in service a new type of motor-propelled and dumped vehicle which takes the place of no less than 15 to 20 horse-drawn carts of the usual type. It is shown by the accompanying illustrations.

The new truck is not like anything else of its kind. It has an underslung frame, and the sides are so arranged that it never is necessary for those loading the vehicle to lift ash cans more than waist high. The truck will hold about 120 cans of ashes. The body itself, which is made of steel, is 13 feet 3 inches long and 7 feet 6 inches wide, the rated capacity being 252 cubic feet. Both the sides and the top are removable sections. The dumping mechanism is operated by the motor and in the hoisted position the body rests at an angle of 53 degrees. Thus, the load can be dumped at any prescribed spot, or may be slid directly into the scows used for such purposes.

The truck now has been in use for some time, making the haul to the dumping ground—a run of about three miles—in 14 minutes on the average. One man drives the truck and operates the dumping mechanism, and as it has a capacity equal to five of the ordinary horse-drawn carts, the saving in operating expenses is material.



The ash cans need be lifted only waist high.

The load can be dumped at any prescribed spot.

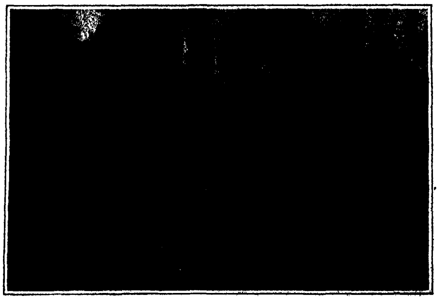
Road Structure and the Commercial Car

By K. G. Martin

COMMERCIAL car manufacturers should come to an appreciation of the very great need for concerted and definite action on their part in the matter of modern road construction.

Those who have to do with pleasure vehicles have from time to time evinced some interest in the matter and we have, of course, our good roads associations. There has been lacking, however, that knowledge and desire for knowledge among the builders and users of modern trackless freight carriers regarding road structure that constitutes so essential a forerunner to combined and effective effort.

Undoubtedly by far the greater field for the motor truck lies in our rural districts, and it is here that the greatest work is to be done in putting upon a scientific and commercial basis road building on a large scale, and just so energetically as the truck-makers fight for good roads just so quickly will come their returns from this almost virgin field. We hear much of service stations and the like, but is it not the part of really worth-while service to be constructive in its nature, and to endeavor to improve and perfect the road surfaces over which the road vehicles are to travel? It would seem so, for notwithstanding all the care and effort put into the design and construction of a commercial motor car, the forcing of it over badly paved highways at commercially necessary speeds will bring about its disintegration in an alarmingly short time. It is not too much to say that the ratio of the weight of the empty truck to the weight of the load it will carry could be greatly reduced if it were known that it would not be required to so fashion the structural members—frame, ties, struts, axles, wheels, etc.—that they must be able to withstand without fracture or permanent distortion many times their ordinary working stresses.



Unretouched photograph of road surface, showing disintegration of the top layer due to flow under traffic.

Another and most important phase of the truck question, and one that affects the utility of this up-to-date beast of burden to a marked degree, is the matter of speed. It is not alone to its surefootedness, freedom from sunstroke, rapid acceleration and deceleration, that the vogue of the motor-wagon is due, but in a very great measure to the saving of time effected through comparatively higher speed. The higher the speed can be pushed the greater will be the saving. Why, therefore, is the speed of motor trucks held to-day within such low limits? We know that outside of "joy riding" and "scorching," and barring drunken and otherwise palpably unfit drivers, that increased speed in motor travel does not mean a proportionate increase in the number of accidents.

But the speed of commercial cars is strictly limited in the majority of cases, either through gearing or through direct engine control, so that the driver cannot exceed a certain predetermined maximum rate. Evidently the speed limitation is set by the manufacturers, who have learned by their own experience, or by that of others, at what speed their vehicles can travel over the poorest road conditions to be encountered without a total collapse.

The methods of road work in the United States and in Europe are dissimilar in many respects, the point of differentiation most interesting to us being the feature of maintenance. Roads are built in this country—and rebuilt. They are constructed sometimes with exceeding care, and are then neglected until they have been so far disrupted and broken that they not only cease to serve as highways, but are even unfit to form the foundation of a new road surface, and have to be entirely rebuilt.

We can and do build good roads, but we do not take care of them. Maintenance, as understood and practised in France, for instance, is non-existent in this country. France has undoubtedly reached the high-water mark in roadways, and its main thoroughfares are a delight to behold and a joy to travel over, and there is absent that only too well-known feature of American touring—fifteen miles of perfect roadway, hard as nails, dustless, beautifully cambered, with just the proper heel at the curves—then, five miles of broken stone, soft fill, steam rollers, and fresh tar oil.

In cities, where the pavements are being constantly disturbed for the repair or extension of subsurface utility structures, and the original tenacity and combined resistance of the surface and foundation are impaired, both as regards their immediate relation, and the relation of that particular section to the surrounding and adjacent roadway, it is not surprising that sinks and pits develop. But in the suburban or country roads of either the plastic or pressed dirt type, it is often difficult to account for the holes that occur. As a rule, these can be traced to an original minute flaw or abrasion that, in the absence of the constant inspection and replacement that should prevail, develops under the pound and rack of traffic into an ever widening and deepening opening. Occasionally they can be traced to a cut or break caused by the solid rubber or steel-shod wheel of a heavy vehicle. This has led some people to suggest the strict limiting of the weight of commercial motor cars that may be operated over such roads, but it would seem rather that the roads should be built to stand the traffic.

There is one element of road disturbance which should merit attention from the truck-maker, as it has developed since the motor truck has come so largely into use. It is the "flow" of road surfaces under the influence of heavy traffic, and reaches its most noticeable and destructive form in city streets where the traffic is unidirectional. If a grade exists, the effect is intensified. In the case of an asphaltic or plastic covering the surface is stretched and forced down the grade to some point where the resistance is sufficient to withstand the pressure exerted by the rolling-out action of the wheels, and at this point the surface is forced into ripples and billows that are soon cut in their turn into ruts and holes. In the case of rectangular creosoted wooden or asphalt composition blocks there can, of course, be no such rolling out of the blocks, as they move

(Concluded on page [illegible])

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the Scientific American.

Aeronautics.

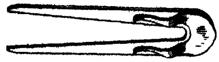
PYROTECHNICAL ILLUMINATING DEVICE.—E. Hyra and K. [illegible], Vienna, Austria-Hungary. The invention provides a pyrotechnical luminous body which will be automatically ignited when dropped from an aircraft. The frame carrying the luminous body is capable of receiving a written communication and the luminous body will indicate the place where the manuscript rests when it reaches the ground.

Pertaining to Apparel.

HAT FASTENER.—G. A. Ulrich, City of Mexico, Mexico. An improved method of holding hats on the head is provided by this invention. The hat is furnished inside with combs which are pressed by a spring member into the hair, but which may be withdrawn from the hair, when it is desired to remove the hat, by means of pins secured to the combs but extending to the outside of the hat.

BLOOMER SKIRT.—M. Langman, 47 Elton Street, New York, N. Y. This bloomer skirt is especially adapted for use when exercising, skating, swimming, riding or the like, and is arranged to permit free movement of the limbs. It consists of bloomers with integral overlapping front flaps and rear flaps which may be fastened together to provide a skirt effect.

HAIRPIN.—H. Jacobsen, Address Ardon B. Judd, care of Capps, Cantey, Hanger & Short, Fort Worth, Texas. It has been found that the ordinary hairpin of the bifurcated type when not securely placed in the hair is very likely to jar or slip out and be lost. To obviate this, the present invention provides the hairpin with means for gripping the hair so that it will remain in place.



HAIRPIN WITH HAIR-LOCKING MEMBER.

Electrical Devices.

FIRE ALARM CIRCUIT CLOSER.—B. Trent, 50 Chester Avenue, Clifton, N. J. The invention provides in connection with a pair of conductors forming a part of a fire alarm system a third conducting member held inoperative by a fusible connection, so that in case of fire this connection would melt, releasing the conductor and permitting it to drop upon and make contact with the two line conductors, thereby sounding the alarm.

Of Interest to Farmers.

PLOW.—O. L. K. H. Oldenburg, Mount Moriah, Natal, South Africa. This invention provides a plurality of plow shares and mold boards mounted on a shaft adapted to be rotated, the boards being curved in the manner of a screw propeller blade, so that they will cut the ground and turn it over thoroughly, one mold board extending beyond the vertical plane of the land side of an adjoining plow member to work more thoroughly the surface of the ground between the end plow members on the shaft.

Hardware and Tools.

WRENCH.—J. H. Kuhns, address Curry & Spillers, Tulsa, Okla. This improvement provides a wrench for use in any work, especially for turning pipes and other cylindrical objects, wherein the movable and fixed jaws are connected by a rack and gear wheel, and wherein a pawl is provided for locking the gear wheel from rotation to hold the jaws in fixed position.

NOZZLE.—H. Birnbaum, Rapid City, S. D. The object here is to provide a nozzle which will permit of the discharge of various sized streams therefrom, and which may be readily and quickly adjusted to vary the size of the stream, and a further object is to provide a nozzle with means whereby a spray may be discharged along with any of the streams of water when it is so desired.

Heating and Lighting.

OIL-BURNER.—W. T. Dowling, Delia, Kansas. This oil burner is adapted to be used in stoves, and comprises a base having a pan at one side for oil to start the burner and a gooseneck leading from the open base and terminating in a bell over the pan. The air and fuel enter the burner in the top of the bell. After the burner has been started the flame burns around the mouth of the bell.

STOVEPIPE SHIELD.—E. Gies, Mount Angel, Ore. This shield serves to protect adjacent walls, buildings, trim, furniture, and other structures from injury by heat emanating from the stovepipe or other element with which the shield is employed, which can be readily mounted in position and as readily taken down, which comprises a plurality of interchangeable sections which may be of any desired number, and which requires no structural change in or addition to the stovepipe with which it is employed.

HOT-AIR FURNACE BONNET.—W. F. Daw, care of the Wilbur E. Steele Co., Hartford, Conn. The bonnet is made of parts so designed that the bonnet can be shipped from manufacturers or jobbers in collapsed form to the point of installation, as the parts can be readily locked or fastened together without special machinery or particular skill to form the complete bonnet for application to the body of the furnace.

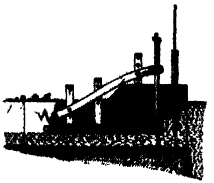
CONTROLLING DEVICE FOR WATER-HEATING SYSTEM.—J. E. Goodwin, 80 Walnut Ave., Norwood, Mass. To eliminate expansion pipes in water-heating systems this invention provides a casing having two valve-controlled communicating openings, one being a relief valve and the other a pressure reducing valve. The device is easily accessible for inspection and causes a quicker circulation of water, therefore permitting a reduction in the size of the pipe.

Of General Interest.

AIR TANK.—W. V. Garceau, Grand Rapids, Mich. This improvement relates to tanks and more particularly to compressed air tanks, the purpose of the invention being to provide a compressed air tank in which, under suitable conditions, the body portion of the tank expands and contracts according to air pressure carried—or in other words, according to the amount of air contained in the tank. The invention is of special service where lightness combined with small volume and freedom from mechanical complications is desirable.

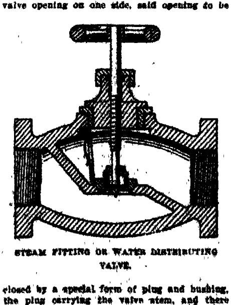
AIR TANK.

CONTROLLING DEVICE FOR WATERWAYS.—W. L. Hurst, Box 572, Aspen, Colo. This inventor provides a device for use in irrigating ditches and other waterways, and arranged to automatically regulate the volume of water flowing through the ditch under normal conditions, to keep the controlling device automatically free of accumulating trash and other extraneous matter, and to automatically close the waterway in case of a flood.



CONTROLLING DEVICE FOR WATERWAYS.

VALVE.—J. A. Wilson, 18 Abbott St., Detroit, Mich. The primary object of this invention is to provide a valve body having a valve opening on one side, said opening to be closed by a special form of plug and bushing, the plug carrying the valve stem, and there being provided a pivoted check valve adapted to close automatically against the inner edge of the bushing when the valve is removed.



STEAM FITTING OR WATER DISTRIBUTING VALVE.

SALES DEVICE.—F. W. DeWitt, Box 286, San Francisco, Cal. In dry climates it is difficult to sell cigars from the top of counters because they dry out very quickly. Accordingly, Mr. DeWitt has invented a device consisting of a series of jars in which the cigars are held for display, and which may be individually uncovered, and tilted toward the customer by the operation of finger keys.

UMBRELLA-PROTECTOR.—H. C. Anderson and A. P. Kemmer, 2461 Frisby Avenue, Westchester, New York. The invention provides an insulating and cushioning protector for the tip of the umbrella rod to protect the person carrying the umbrella from the effect of shocks from electricity and to prevent injury to the joints and catches of the umbrella when it is used as a cane.

CASTING OF IRON.—I. E. Lester, 44 Sandwell road, Handsworth, Birmingham, England. The object of this invention is to provide simple and reliable means for imparting a hard surface to an iron casting for the resistance of wear, while retaining that toughness in the body of the casting which is necessary for the resistance of stresses liable to cause fracture or breakage.

HALTER.—R. Scott, care of Harvey B. Dick, 329 Second Ave., East Kalispell, Mont. Mr. Scott's invention relates to halters, and it has for its object the provision of one having two parts of tubular steel which telescope, and which are normally positioned on the horse below his eyes, straps being provided for holding the tubular steel parts in place.

Machines and Mechanical Devices.

FIRE FIGHTING APPARATUS.—S. H. Willis, 582 Broome St., New York, N. Y. This invention provides a mechanism to support a fire hose at an elevation for fighting fires, the nozzle being manipulated to play the water on the fire in simulation of manual manipulation; and provides a supporting mechanism upon an extension ladder with nozzle manipulating means operable from the foot of the ladder.

PROCESS OF STERILIZING AND PACKAGING RICE.—W. S. Davis, Jr. Address Seaboard Rice Milling Co., Galveston, Tex. The shaker, the bin, the packaging machine, and the cartons are covered and protected, preferably by sheet metal hood or hoods, so that fresh or cool air is prevented from access to the heated rice from the point of its discharge from the drier to its delivery and sealing in the package, whereby the cracking and breaking are effectually avoided.

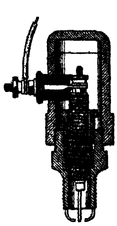
LIQUID MEASURING DEVICE.—E. A. Apfell, 793 E. 168th St., Bronx, N. Y. The object here is to provide a liquid measuring device for measuring liquids periodically drawn from a barrel or other container. As the amount of air passing into the container by the way of the liquid measuring device is the same as the amount of liquid withdrawn, it follows that the amount registered by the registering end indicates the amount of liquid withdrawn from the container.

CLEANING AND SCOURING ATTACHMENT FOR METAL ROLLS.—J. Dunlop and J. D. Davidson. Address the former, 909 Center St., Wellsville, Ohio. This invention is particularly intended for cleaning and scouring the surface of metal rolls used for rolling steel plates or sheets. The apparatus used is automatic and produces a roll face which is smooth and uniform, steel sheets being rolled flat, without stopping the normal operation of the mill, so that an important economy and perfect mechanical result are effected.

ROPE CLAMPS.—S. E. Ryder, 817 N. J St., Muskogee, Okla. The improvement is on that type of rope clamps whose chief parts are a frame, jaws or clamps proper hinged thereon, and a screw relatively connecting the outer ends of the clamp arms which project laterally from the jaws, so that by rotation of the said screw, the jaws may be clamped upon the rope with any required degree of pressure.

Prime Movers and Their Accessories.

SPARK PLUG.—J. DeL. Barmore, Box 316, St. Vincent Island, Apalachicola, Fla. A contact member is provided which is surrounded except at the ends with an insulating material, and is clamped or connected with a supporting screw member which is designed to be secured into the cylinder of an engine, and to which is secured by suitable threads a protecting housing. A water-tight insulating member is provided for carrying the wire into the contact member so that a plug can be used at any desired place even though the same is submerged in water.

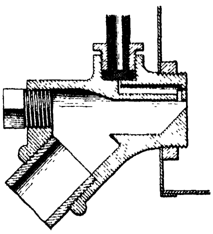


SPARK PLUG.

ROTARY VALVE.—C. H. Bantley, Lebanon, Mo. Use is here made of a rotary admission valve and a rotary exhaust valve, each valve consisting of two revoluble valve cylinders, one within the other and rotating in opposite directions, the valve cylinders having ports adapted to register with each other, and at the same time with a corresponding cylinder admission or exhaust port.

Railways and Their Accessories.

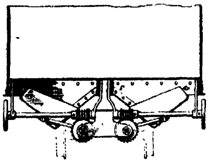
TRACK SANDER.—J. H. Watters, Augusta, Ga. Mr. Watters' invention has for its purpose to provide a track sander, simple in construction, the sander having an air jet which is disposed to discharge the air against an inclined bottom member serving to direct the air together with the sand to an outlet disposed below the inclined bottom member. As there is practically no blasting against the sander casting proper there is little, if any, cutting action.



TRACK SANDER.

STATION-INDICATOR.—C. S. Emery, 713 South 20th St., Birmingham, Ala. This station indicator is adapted particularly for use on street cars to indicate to the passengers within the cars the various streets as they are reached. The indicator is actuated by plugs located on the tracks which engage a tripping member connected by suitable gearing to the indicator.

DUMP CAR.—J. D. Mettler, Snydertown, Pa. This inventor provides a car having hinged bottom portions which may be easily moved to effect the dumping of the contents of the car, especially coal, and which may be readily secured to hold the load without any danger of dumping the same in transit. He provides a device having means for draining water from the load, and at the same time preventing leakage of portions of the material which is being transported.



DUMP CAR.

Pertaining to Vehicles.

TIRE.—R. E. Sturman, Delano, Minn. The purpose in this case is to produce a tire which will have all the advantages in the way of resilience that are obtained by the use of pneumatic rubber tires, and which will in addition be more expansive than tires of the pneumatic type referred to.

Designs.

DESIGN FOR A LOVING CUP OR SIMILAR RECEPTACLE.—W. H. Head, Hookset, N. H. The cup comprises a standard and a bowl shaped like an inverted cone. The bowl is provided with three handles, and there are six spoon-shaped ornaments symmetrically disposed about the cup with the bowls of the spoons clustered about the upper part of the standard.

NOTE.—Copies of any of these patents will be furnished by the Scientific American for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Road Structure and the Commercial Car

(Concluded from page [illegible])

in a solid mass, curving out from the curb at each side, those nearest the curb being held by the greater friction in almost their original position, those at the center being the keystones of an arch that has its apex pointing in the direction in which the traffic is traveling. Seams are thus opened up at the beginning of the stretch of roadway affected, causing bad bumps to heavy vehicles passing over them, and at the end of the stretch, blocks are often forced completely out of place. This curious glacial movement should, as has been said, have particular interest for the truck maker and user, since it is directly due to heavy motor traffic, and reacts directly upon that traffic in a deleterious manner. The matter of foundations for road structures should receive the most careful attention from those interested in the welfare of the commercial motor vehicle, for while the surfacing is most in evidence, and while it does the actual carrying of the load and must be depended upon for taking the brunt of the work, it can only do its share and no more.

Let us consider for a moment railroad work. Here the quality, weight and strength, as well as a number of subordinate but co-ordinate factors, of the steel rails, ballast, spikes, ties, plates—all that go to make up the railroad roadway, are known. The various parts are selected for their individual and collective efficiency, and these efficiencies, governing the safety, speed, and tonnage of trains and engines, are known, not only to the line's operating department, but to the builders of the coaches, gondola cars, Pullman diners, locomotives—in fact, to all those who manufacture rolling stock of any nature for the railroad's equipment. It may be said, and quite truly, that the railroad company not only runs the trains, but is also responsible for the roadbed; that is one reason why the railroads are able to provide the wonderful service that they do. Does it not seem as though it were up to the motor-truck manufacturers to take a hand in the building and maintenance of the roads and streets—the "rails" over which their "rolling stock" has to travel and demonstrate its worth to the commercial world?

Motor Truck Notes and Queries

L. L. S. writes: "There is an annoying squeak that seems to come from the springs of my one-ton truck. The machine has recently been overhauled, but it may be that the springs were not properly lubricated. What oil should be used, and how should it be applied?"

A. The frame of the car should be jacked up so that the axle is suspended from the springs. This will tend to separate the leaves of the springs somewhat, and then a mixture of thick oil and graphite or a graphite grease may be introduced between the adjoining surfaces of the leaves by means of a thin-bladed knife. Special devices are on the market, by means of which the leaves may be separated by tightening a nut that serves to introduce a wedge-shaped point between adjoining leaves. Although a portion of the truck that is too often neglected, yet it is the springs that are subjected to almost continuous work when the machine is in motion.

T. P. P. writes: "I have 4½-inch pneumatic tires on my delivery car, and desire to keep them pumped up to the pressure recommended by the manufacturers. What are the so-called 'spark plug tire pumps,' and are they injurious to the tire?"

A. The pumps to which you refer consist of a double cylinder, one end of which is designed to be screwed into the spark plug opening of one of the cylinders. When the engine is run on the remaining cylinders, the compression in the "dead" cylinder operates the plunger of the cylindrical pump, and *fresh* air is pumped into any tire with which the long tube extending from the pump may be connected.

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Inquiry No. 9359. Wanted the name and address of a firm that makes razor blades for all makes of safety razors.

Inquiry No. 9360. Wanted the name and address of parties making pipe fittings such as ferrules, stems and bowls such as could be used in the making up of calabash pipes for smoking.

Inquiry No. 9361. Wanted to buy a Nut Cracking Machine, especially good for Pecans.

Inquiry No. 9362. Wanted the name and address of the makers of a machine for splicing ties.

Inquiry No. 9363. Wanted the names and addresses of manufacturers of machinery for printing on intaglio copper plates.

Inquiry No. 9364. Wanted the name and address of buyer of mica in a crude state.

Inquiry No. 9365. Wanted the name and address of a manufacturer of machinery for embossing tin foil as is used in packing cigarettes.

Inquiry No. 9366. Wanted the name and address of a manufacturer of wire wheels, front axles complete with steering or separate, light sheet metal bodies, fuel tanks with cocks, pressed steel frames, mufflers, motors of the two-cylinder opposed type, cushions and many smaller parts for cycle cars.

Inquiry No. 9367. Wanted the name and address of a manufacturer of an automatic [illegible] machine.

Inquiry No. 9368. Wanted the name and address of glass-bottle manufacturers or glass blowers who can manufacture a glass bottle and perforate it with some 12 small holes, in large quantities for export, to sell at a popular price.

Inquiry No. 9369. Wanted the names and addresses of users of Indian [illegible], [illegible] and other Indian minerals, in quantities.

Inquiry No. 9370. Wanted the names and addresses of manufacturers of small wooden articles, particularly in such soft woods as pine and fir, for articles such as toys, furniture, etc.

Inquiry No. 9371. Information wanted where one could buy or have made to order machinery to be used for making solid back brushes.

Inquiry No. 9372. Wanted the name and address of [illegible]

Inquiry No. 9373. Wanted the name and address of a manufacturer of machinery [illegible]

Inquiry No. 9374. [illegible]

Inquiry No. 9375. [illegible]

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If a gauge is used to determine the correct pressure, you will find that these gauges give excellent results at a great saving in time and labor. Inasmuch as the pure outside air is pumped, the objection that the uninformed hold against them—to the effect that the gasoline in the mixture as it comes from the cylinder and is pumped into the tires, tends to rot the fabric—is seen not to be valid.

Basket Willow Culture in the United States

(Concluded from page 439.)

according to the soil. In moderately moist, porous soil they should be from 8 to 10 inches, but where the water level is below 6 feet they should be 12 inches long. To plant them too close together or too far apart reduces the commercial value of the crop. From 9 to 12 inches apart in the row and 2½ feet between the rows is the usual spacing followed. If planted far apart they produce thick tapering rods, which are less valuable.

Harvesting the rods begins about the middle of January, and this work must be completed before the sap commences to rise. The young shoots are cut with a short hooked knife as close to the stump as possible. The rods are next tied into bundles and placed in a pit of running water from 4 to 6 inches deep. They are left in the pit until the sap rises, when the bark is easily removed. This is known as sap peeling. Another method, known as steam peeling, consists in steaming or boiling the rods until the bark loosens, when it may be removed by hand. The apparatus for peeling consists of a round steel rod from ½ to ⅝ of an inch in diameter and about 4 feet long, which is doubled over so that the two ends are brought together, making a double rod 2 feet long. The lower or welded end of the parallel rods must be inserted vertically in a log placed at a convenient height. The operator places the thick end of the rod between the prongs and draws it toward him, and the bark is separated from the wood. The small end is then treated in a similar way, which completes the operation. The next operation is grading the rods into proper height and quality classes, after which they are bundled up and prepared for market. The market price for green unpeeled rods, cut and delivered at the railroad, ranges from $10 to $30 per ton. From 4 to 8, or sometimes 10 tons, may be grown on an acre. The crop from an average acre should bring $150, of which one half should be net profit.

In Pennsylvania and Maryland the willow growers prefer to cultivate the American green willow, which produces longer and stouter rods. The methods of culture and of handling the product after harvesting are practically the same as in New York, and it will be unnecessary to enter into details, but simply note one or two points in what may be called the Pennsylvania-German system. Here cuttings are planted in rows of from 18 to 24 inches apart and from 8 to 10 inches apart in the rows. This method of spacing renders the stand very dense. In this region willows are considered wet-soil demanding plants, and nearly all plantations occur along streams. In New York the best land on the farm is appropriated for growing willows, because this crop in rich soil and under intensive management yields a return equal to or greater than most other farm crops. While these plantations produce rods of the highest quality, it must be admitted that many plantations in Pennsylvania and Maryland produce a quality of rods that cannot be surpassed in any part of the country or even abroad, where willow culture has been practiced for over 800 years.

The Principle of the Bicycle Applied to the Motor Car

(Concluded from page 443.)

the car is on an even keel the rack R and the pinion U are not in engagement, but a very small upward movement of the rack is sufficient to establish such engagement.

It will thus be seen that if the car swings over to the right the left-hand rack R and pinion U are brought into mesh. If the swing

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This is one of the G. V. Electric trucks used by the Bethlehem Steel Company. The daily mileage is small but the truck solves the problem of yard transfers at minimum cost.

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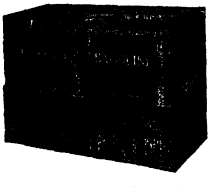

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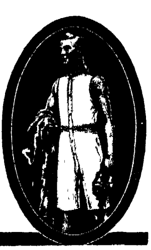

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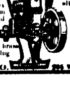

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is to the left the right-hand rack and pinion are engaged.

We now come to the gyroscope and its details. The gyroscope wheel *A* (Fig. 3) is mounted inside a cage consisting of top and bottom plates *B B*, four corner pillars, and two cross bars *C* These cross bars are provided with pivots *D*, which pivots are carried in bearings on the pillar *P* (Fig. 2) directly behind the pin joint *Q*. Returning to Fig 3, it will be noticed that the plane of rotation of the gyro-wheel is above the line through the pivots *D*. In this respect Mr. Schilowsky claims that his system is different from the gyroscopic monorail carriages of other inventors The difference seems little enough, but it has a very marked effect on the behavior of the device It would, however, lead us, were we to discuss this point fully, into a long and tedious mathematical analysis of gyroscopic phenomena in general Suffice it to say, then, that the gyroscope spindle *E* is directly connected to an electric motor carried on the lower plate *B* (Fig 3) and indicated by the dotted lines *F* The speed of rotation of the gyro-wheel is 3,000 to 4,000 revolutions per minute.

The upper end of the gyro-spindle carries a worm *G* which meshes with a worm wheel *H* carried on a shaft *J* This shaft is journaled in bearings on the top plate *B* and is disposed crosswise of the car that is to say, at right angles to the track. At one end the shaft *J* carries a gear *K*, which, meshing with a second gear *L*, transmits motion to a second and parallel shaft *M*. At the other ends of the shafts *J* and *M* are pinions *U*, which pinions are those similarly referred to in Fig 2 It is clear that if the gyro-wheel is rotating anti-clockwise when viewed from above, the direction of rotation of the gears will be as shown by the arrows Viewed as drawn in Fig 3, the left hand wheel *U* has a clockwise rotation and the right hand one an anti clockwise

Imagine, once again, that the car is lurching over to the right. As all acquainted even but slightly with the properties of the gyroscope are aware, such a movement as this—or, to be quite exact, the application of the torque implied by this movement—will cause the gyroscope to precess round an axis at right angles to the axis about which the movement is taking place This last axis is, of course, the line of motion of the car, and the axis about which precession is set up is that of the pivots *D* (Fig 3) With a right hand lurch the upper end of the gyro-spindle *E* goes forward, so that the pinion *U* on the left-hand side moves into some such position as *W* (Fig 2)

So long as a lurching over to the right continues so long will the gyroscope, if left to itself, continue to precess But it is not left to itself As we have said above, a right hand lurch causes the left-hand rack *R* (Fig. 2) to rise, and the lurch has not proceeded very far before the rack and the rotating pinion *U* come into mesh As soon as this occurs the precession is checked, for the pinion *U*, rotating in the direction of the arrow *X*, obviously will pull the rack round on its pivot *Q* in the direction of the arrow *Y* Under these circumstances, then, the precession is checked by the force of the spring *Z*

Now, when the gyroscope is mounted as is this one, and when its precession is checked, it develops a torque about an axis—the line of motion of the car—at right angles to the axis of precession Why it should do so cannot be explained without a considerable amount of analysis But we may say that the same fundamental principle is at work here as in the case of an ordinary spinning top It is a matter of common observation that if we hasten the precession of a top it will lift its axis more nearly vertical If we check or retard the precession the axis tends to fall

In the case of the gyroscope in the Schilowsky bicycle automobile the torque developed by the checking of the precession opposes the lurching, so that the overturning couple is overcome The restoring couple developed by the gyroscope continues in action until the car has so far righted itself that the rack is lowered by the pendulum out of engagement with the pinion *U* In actual running it requires very close watching to discover that the gyroscope is continually processing in one direction or the other But it can be seen and at the same time it will be noticed that the racks *R* are continually rising, checking the precession, and falling again

The inventor claims that a mono-track motor car, running under gyroscopic control, may attain a given speed and efficiency with a much less powerful engine and with a lighter frame and body-work than would be required for a four-wheeled car of the same rating. He also points out that a mono-track car requires only the narrowest of paths, hence its special applicability for use in new and undeveloped countries Further advantages are said to be a gain in smoothness of running, a lessened fuel consumption and cost of production, and a gain in safety when running at high speed on horizontal curves

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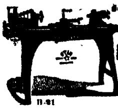

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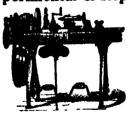

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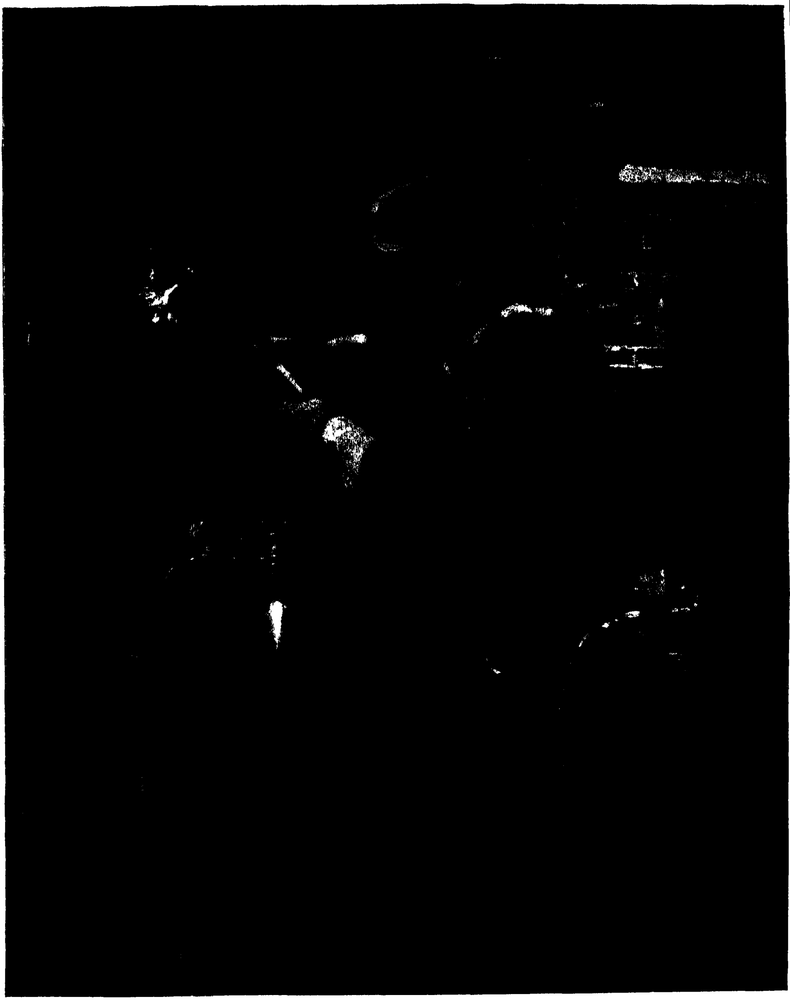

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Vol. CX. No. 23
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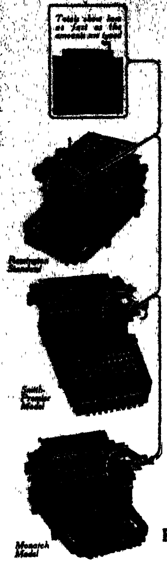

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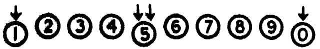
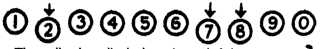


The figures are typed on the bill head.

Now look in the totalizer! Right in front of you it flashes 0 000 015 50

Now for your next item. Call it a barrel of flour @ $7.28. Type 7.28



The totalizer immediately shows the total of the two amounts—0 000 022 78

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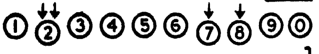

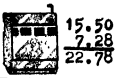

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Saxons are selling fast—faster than we ever dreamed they would. It must be a case of first come, first served. So the only way to avoid being one of the disappointed is to see your dealer and order now.

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SAXON MOTOR COMPANY
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If you will send us your name and address we will mail you our 64-page illustrated catalog, which tells all about GRAFLEX CAMERAS and how they work. Be sure to specify *Graflex Catalog.*

FOLMER & SCHWING DIVISION
EASTMAN KODAK CO.
ROCHESTER, N. Y.

An automobile should weigh less than 3000 pounds

WHEN we say "Automobile" we mean the average type of car, the five-passenger touring car of 120-inch wheel base. That is the correct length of car for comfort. Less length is not enough. More is unnecessary.

Up to a year and a half ago all cars of this size—both four-cylinder and six-cylinder—weighed from four to five thousand pounds. Most of them still do. That's *two to two and one-half tons.*

Is such weight *reasonable?* Is it *necessary* for *safety* and *durability* and *comfort?* Some manufacturers would ask you to *think so,* but can you imagine it? Three or four years ago it *was* necessary,—not for safety or durability or comfort, but simply because no manufacturer *knew how* to build *lighter* cars and *build in* the required qualities.

The world moves. *Some* of the *people* stand still for a time, but the *world* goes on. And with the rapid development of automobiles came a parallel *demand* for *lighter weight,* just as came the demand for six-cylinder *continuous, smooth* flow of power.

The public said: "We *want* cars. We know the pleasure of the automobile. We know its utility. But we are staggered by the expense. Tires wear out so fast and they cost so much! The motor eats up so much gasoline and it costs so much! Why can't *lighter* automobiles be built, with *just* as much safety, just as much durability, just as much comfort? Why not?"

Well, *why not?* A couple of years ago *some manufacturers* began to think seriously on that question. Among them were the men who built the first Chandler Light-Weight Six a year-and-a half ago,—men who had been designing and building and selling the highest grade motor car in America for years. And for years before that, the finest bicycles.

We certainly knew motor car construction, we knew six-cylinder construction, we knew automobile engineering, we knew that the demand for light weight was logical, and we felt sure we could build a six-cylinder car of 120-inch wheel base that would possess every known degree of safety, of durability and of comfort and *not weigh more than 3000 pounds.*

How, you may ask, did we hope to cut off that fifteen hundred or two thousand pounds!

Someone suggests that light weight comes from cheap materials. Not at all. *Cheap iron* is just as heavy as *good* iron.

We were going to *cut out the iron.*

And we cut it out.

It's the people who haven't cut out the iron that are "warning" you against light weight.

We cut out the heavy castings that add weight but *not* strength to a car. And what did we use in their stead? *Aluminum,* and *pressed steel.*

Are they as strong? Ask any engineer you chance to know.

It takes two men to lift a *cast iron* crank-case. But you can put an *aluminum* crank-case under your arm and walk away with it.

Which would you rather have, the cast iron or the aluminum?

Another factor in the Chandler light weight is the use of high-grade, efficient, imported ball bearings throughout in place of the heavy friction-producing roller bearings with their heavy cases and carriers.

And so on, all through the Chandler, we cut out *weight* without sacrificing one single degree of strength.

Is it *durable?* Ask any Chandler owner. We will refer you to as many as you want, and in any part of the country you say. *Of course* the car is durable. We started with a *clean slate,*—no errors to forget, no faults to overcome, and we built it so that it *had to* endure.

Is it *safe?* A year's service has brought no report of a *break-down.* Hundreds of owners have done five to ten thousand miles without a single repair. In the Swedish Reliability Test, conducted by the Swedish Royal Automobile Society in February—over 800 miles of storm-wrecked roads that experts declared impassable—the Chandler was the only American-built entrant with no failure to finish. In all other endurance tests it has finished with honors. Do not these qualities spell safety? The Chandler gives you *100 per cent safety.*

Is it *comfortable?* We will let you answer that for yourself. The car will tell you all about comfort better than we can. Go to your Chandler dealer—there's one in every principal city in America and in hundreds of smaller cities. Go to him and say, "Prove to me that a car weighing less than 3000 pounds is as comfortable as the heavy cars. Let me pick out the roads. Drive me where I want to go. Get away from the boulevards. Take me fifty miles out through the country and *drive fast.* Hit all the bumps. Let's see if it's comfortable."

Put it up to the Chandler man just like that. Don't worry about hurting his feelings. He's *waiting* for you.

Heavy Car Builders Do Not Name Weight

You have noticed, of course, that practically all manufacturers are *talking* now about lighter weight. But it's mostly just talk. Read the advertisements, "A light car and a speedy one," "How much should an automobile weigh," "The unmistakable demand for light weight," "Our car is 300 pounds lighter," "Our light six is just the right weight," and so on and so on. A lot of fine sounding talk, but NO FIGURES. If they are proud of 3700 lb. weight or 4000 lbs., or 4500 lbs., why don't they *name* the weight! And have you noticed that the *only* cars whose weights are *advertised,* weigh less than *3000 lbs.?* All the others will name their weights, too, when they reach the 3000 lb. mark, *but not before.*

CHANDLER $1785

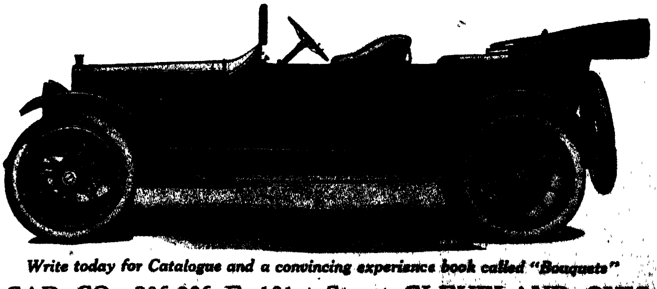
LIGHT WEIGHT SIX

Weighs 2885 pounds fully equipped
Runs 16 miles per gallon of gasoline
Averages 7000 miles per set of tires
Speed, 3 to 55 miles per hour on high gear

Remember the Bicycle!

YOU probably recall the 60-lb. bicycles. *Everybody* made them heavy, and a "century run" was an *event.* Then a pioneer who was *thinking* cut off 28 lbs. in one stroke. Built bicycles that weighed 32 lbs. Other manufacturers *warned* the public. Said light weight bikes couldn't *stand up,* and would "jolt the rider all to pieces." Within two years *all bicycles* were *light weight, lower priced,* stronger, more durable, just as *smooth-riding* as ever, and century runs were *commonplace* because of the *economy in power.*

History is repeating itself.



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SEVENTIETH YEAR

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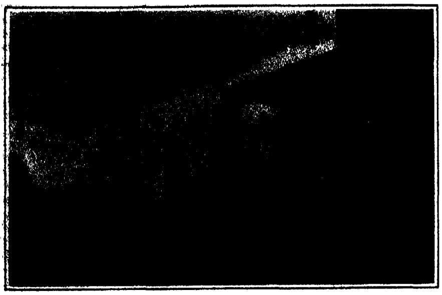


Threatening to engulf a cottage.

The ice piled itself up in huge billows.

An Ice Flood

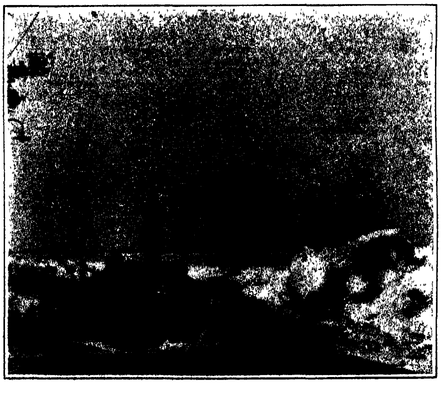
By W. F. Anderson

ON the afternoon of Easter Sunday there occurred at Sylvan Beach, N. Y., on the shore of Oneida Lake, a very sudden transfiguration of the scenery, as will be observed from the photographs shown. A field of ice came up out of the lake like a tidal wave and piled itself in huge billows upon the shore.

The ice on the lake averaged about 12 inches in thickness and was melted along the shore for a distance, on the average, of about a hundred feet out. At this particular time a severe gale began blowing and moved the ice shoreward with such force, that, from the momentum gained, it was forced out upon the beach and over the concrete sea-wall. In some places the sea-wall was entirely wrecked. The ice continued to pile up till, within a period of twenty minutes, it had reached a height of thirty feet in places, and reached along the entire length of the southeast shore of the lake.

One picture shows the ice piled on top of the roof of the front porch of a cottage. This cottage was practically demolished and the whole interior was filled with ice. There was no way of combating this glacial flow.

Old inhabitants of this vicinity claim that a phenomenon such as this has not been seen here for over twenty-five years.



In some places the concrete sea-wall was wrecked.

The ice billows reached a height of thirty feet.

How It Feels to Travel by Flying Boat

AN admirer of, and occasional contributor to the SCIENTIFIC AMERICAN, recently made a flight as passenger in a Thomas flying boat, which has been located at Dobbs Ferry, on the Hudson River, for the past few weeks, doing "missionary work" in the cause of aviation. A first flight is always interesting, and an invitation from the manager, F. Rodriguez, to make such a flight with Ralph M. Brown, was quickly accepted. Upon the advice of the preceding passenger, the writer stuffed cotton in his ears first. Slipping on the airman's padded jacket, he stepped aboard the boat at the bow just after Brown had beached her and opened the hinged doors forming the deck of the bow, by pulling a lever. He found a comfortable seat beside the aviator, with plenty of room to stretch his legs. The big 6-cylinder Austro-Daimler up above, between the planes, was running slowly. Two men in hip-boots pushed off the boat and swung it around until it could be steered out into the river. The big engine stopped sputtering and emitted a steady roar. Instantly the boat scooted over the water diagonally across the Hudson. It tore along at 60-mile speed until it "bumped the bumps" on the waves of a passing steamboat. Then perfectly smooth motion and no more spray drew one's attention to the fact that it had left the water and was ascending along a gradual incline. The waves soon appeared to be ripples, and the steamboat a toy craft, as the aeroplane circled around her at a height of 500 feet Brown let the machine tip naturally, and the angle it assumed was such as to make one feel uncomfortable and fearful of side slipping, although the inclination was scarcely any more, perhaps, than a train tips when rounding an extremely sharp curve

Once on the straightway up the river, one had a chance to glance to one side or the other and view the beautiful grounds of the country places, appearing like models of landscape gardens, one tenth of a mile below.

At the 70 miles an hour at which we were flying the wind pressure was so strong, however, that if one turned one's head ever so slightly the pressure on the foremost ear was decidedly uncomfortable Even with cotton in the ears, the roar of the air by them was almost sufficient to drown the exhaust of the motor Tears formed in the eyes, but were quickly blown aside. When provided with goggles and a skull cap, flying at high speed must be delightful and exhilarating An automatic stabilizer will eliminate steep tipping at the turns and a celluloid windshield the strong air pressure. Flying above water at a low elevation is quite as safe as motoring and much more pleasurable, and the reason for the popularity of the flying-boat ferries that have been started in the South and West is easily seen. For the business man who commutes a distance of 50 to 75 miles, a flying boat will *more than pay for itself* in health and pleasure derived in a single season.

A Remarkable Collection of Human Embryos is being made at Johns Hopkins University under the direction of Prof Franklin P Mall, whose private collection constituted the nucleus of the new one. Circulars distributed to physicians throughout the United States and abroad have resulted in the addition of about 150 specimens within six months, many of them unique. Special care has been taken to secure accurate histories of this material. Series of specimens from the collection are lent for study to persons engaged in working out special problems in embryology, and important investigations are also being carried on by Prof. Mall and his assistants.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest If the photographs are *sharp*, the articles *short*, and the *facts authentic*, the contributions will receive special attention Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Lost Through Insufficient Subdivision

THE loss of the "Titanic" with 1,500 souls was due, as we showed at the time, to insufficient subdivision. The rupture of the outer skin permitted the water to fill the ship from side to side, in the compartments affected. An inner skin, laid upon the frames, or in the form of the inner wall of coal bunkers built along the sides of the ship, would have kept her afloat long enough for all the passengers to be saved by rescuing ships.

Since that disaster, the "Olympic," sister to the "Titanic," has been made a safe ship, by the construction of an inner watertight skin some three feet in from the outer shell of the ship

The ill-fated "Empress of Ireland," which was sunk in the St Lawrence, on the 29th of May, with the loss of nearly one thousand souls, as the result of being rammed by a collier, was built under the same faulty Board of Trade rules under which the "Titanic" was built She was provided with nine transverse bulkheads; but she possessed no side longitudinal bulkheads, nor had she any inner skin. When she was pierced by the bow of the collier, the water was free to fill the 65½ foot width of the compartments affected. The inrush of water was so rapid that the ship began at once to list heavily, and *in fourteen minutes this 20,000-ton ship had capsized and gone to the bottom!*

It so happens that we publish, in this issue, the plans of a ship, the "Aquitania," which makes her maiden voyage to New York this week, whose construction, with side bunkers, is such that she could have sustained the blow of the collier "Storstad" without being sunk, and indeed without any serious risk of being sunk The moment the stem of the collier touched the side of the "Empress of Ireland," it was twisted aside, and the bow was so greatly blunted that it would never (had the ship been the "Aquitania") have crushed through the eighteen feet of coal in the bunkers and reached the inner skin

In the presence of this ghastly repetition of the "Titanic" disaster let us keep our eyes on the big facts These hapless people (nigh a thousand of them) were drowned because the ship was not built *unsinkable—and it is perfectly possible to build ships so well subdivided* that they cannot be sunk—certainly not in fourteen minutes—by collision. The "Empress of Ireland," like the "Titanic," was a safe ship, judged by the British Board of Trade requirements as to safety. But *at the time of her construction the safety requirements* of the British Board of Trade were ridiculously inadequate. They allowed a ship to fill two adjoining compartments and bring the top of her bulkheads to within a foot or two of the water and pronounced her *safe when in that condition.* Whether the "Empress of Ireland" filled more than two compartments we do not know at the present writing; but we do know that it took just fourteen minutes to send her to the bottom.

The big thing to remember in the investigation of this disaster is that the one sure protection for a ship against sinking is an inner skin—the ship within a ship The naval constructors have adopted this protection for battleships against the ram and torpedo, and they ought to know.

It is a matter for deep regret that the great International Conference which sat for several months, last winter, in London, did not make the provision of an inner skin obligatory They left it to the judgment of the individual companies and their naval architects

The findings of this Conference await ratification by our Senate. We strongly urge that, in view of the recent disaster, our Government should incorporate a clause making some form of inner skin obligatory on all ships carrying more than a certain number of passengers.

The Regulation of Harbor Traffic

THE growth of population, with its corresponding increase in the density of traffic in our large cities, has led to the organization of "traffic squads," whose sole duty it is so to regulate the movement of vehicles through the streets, particularly at congested points, that it shall proceed with the least possible interruption and in the greatest possible volume Residents of our largest cities will remember how the unregulated traffic would frequently become so completely tangled up as to come to an absolute standstill, and require many minutes to loosen out the congestion and set the mass of vehicles in motion again.

We borrowed the idea of a specially organised street traffic police force from abroad, and it has worked so well in this city, that such a thing as an absolute deadlock in traffic, even at the most congested centers, is now practically unknown.

When we come to consider the question of river and harbor traffic, we find that like causes have produced like results. Of course, there is at present nothing comparable to the confusion and absolute deadlock that formerly occurred on our city streets; nevertheless there is a feeling among shipping men that the time has come for introducing some form of authoritative regulation of the movements of shipping, in order to prevent delay, avoid accidents, and get the maximum traffic efficiency out of the more crowded waterways of our leading ports and harbors.

Not many weeks ago, we had occasion, in these columns, to comment upon a serious accident to one of our ferryboats in the North River, which, as we pointed out, was due to lack of stringent laws protecting the navigation of these boats. The trouble, however, does not come from them; for, as a rule, our ferryboats are superbly handled. Indeed, when we remember that their courses lie largely across the track of shipping in one of the busiest ports in the world, it must be admitted that the work of the ferryboat captains is well done.

The chief obstruction and delay comes from the lighters and other slow-moving traffic. During the period of heavy ebb and flow of the tide, the current is so strong that the handling of heavy loads is extremely difficult, and often the tows are brought practically to a standstill, in which case they become a most serious impediment in the handling of large ships in the river. A notable instance of this occurred in the recent docking of the "Imperator," which, after she was straightened out across a rather strong ebb tide, and was about to enter her dock, found the entrance completely blocked by a tug which was vainly endeavoring to push its heavy tow upstream against the current. The big ship had to drop downstream, with the result that it was some hours before she was finally moored in her berth. Such incidents are liable to occur at any time when the large modern liners are making their piers. There is a feeling among shipping men that the time has come for the appointment at this port of a Harbor Master, who, with his staff, shall serve the purpose of a traffic squad in the North and East Rivers. The large ports of Europe are controlled in this way, and experience has proved that thereby the speedy and safe handling of shipping is greatly facilitated.

Problem of the Permanent Road

FOR many years the management and the engineering staff of our railroads have well understood that the provision of an absolutely first-class roadbed and track, in respect alike of its construction, grades and curvature, was most intimately related to the question of profitable operation, and it is with a clear recognition of this fact that our larger railroad systems have expended during the past two decades hundreds of millions of dollars in cutting out curvature, reducing grades, strengthening bridges, and increasing the weight of rails and fastenings

There is to-day a growing appreciation of the fact that the same economic conditions apply to the construction and maintenance of the country's highways. Here the matter of grades is not of such vital importance; but the importance of providing a solid and well-founded roadbed, properly drained, and provided with a top surface of such a durable character that it will preserve a true and solid surface for a long period of years, is receiving the fullest recognition. It is coming to be understood that the question of first cost has been given undue importance; we now know that the extra initial expense of an absolutely first-class and durable road, that is subject to heavy traffic, is more than compensated by the elimination of costly repairs, and of the great loss (an item which has received too little consideration in the past) due to the long periods of time during which the road is out of service because of repairs.

A few weeks ago, we had occasion to refer to a report of Governor Glynn of this State, in which he showed that there would be an enormous saving of cost over the present macadam roads, with their limited life and their exceedingly costly repair bills, if they were built with a brick surface upon a well-constructed foundation. In this report the Governor states that in New York a mile of macadam costing $12,000 does not last over ten years, and that its maintenance would cost about $1,000 a year, with the result that at the end of ten years the road must be rebuilt at a cost for reconstruction of $6,000 a mile. The total expenditure for twenty years on a mile of macadam road therefore amounts to $36,000, including $12,000 for building, $18,000 for maintenance, and $6,000 for rebuilding at the end of the first ten years. As against this the report pointed out that the total expenditure for twenty years on a vitrified brick road would amount to $26,000 *only*, estimated at a maximum of $25,000 for building and a maximum figure of $50 a year for maintenance.

We find a verification of this report in an address given by Mr. Will P. Blair, at the first Canadian and International Good Roads Congress at Montreal held last May, the subject of the address being the economy of a vitrified brick road. The author lays stress upon the fact that the greatest element in fixing the economy of any road is the very one which is least taken into account; namely, its out-of-repair condition. On many types of road, break-down of the surface is so frequent as to call for almost complete reconstruction; and at such times a stretch of road may be put entirely out of commission. The sum of the periods of times that the road is out of actual service, coupled with the smaller loads that can be hauled over an inferior road, the broken springs, the extra wear and tear of the vehicles, etc., if converted into dollars, might equal, in a surprisingly short period of time, the entire original cost of the improvement.

The author of the paper gives some useful facts as to the experience already had with brick roads in this country. It seems that the main streets of Belleville, East St. Louis, Alton, and Danville in Illinois; of Terre Haute, Richmond, Frankford, and Lebanon in Indiana; and of Portsmouth, Chillicothe, Sandusky, and Conneaut, Ohio, are brick paved. All of these streets, he stated, have more than an average life of twenty years. In Cleveland and other large cities, many streets have brick pavements whose average life exceeds twelve years. Moreover, there are hundreds of streets paved with brick to be found throughout the above-mentioned towns which have been in use over ten years, all of which have not called for a penny of repair work due to wear and tear. The significance of these facts will be evident when it is borne in mind that the average traffic upon these streets is at least twice that of any traffic that is borne upon any part of the country highways of the main market or interurban systems.

Form and Substance

CHANGE is the order of Nature. Yet, in the ever-shifting landscape of the world's events, we have learnt to distinguish two stable landmarks, *Matter* and *Energy*. The recognition of this constancy represents, to the physicist, one of the great central truths of science. But from a more "human" point of view, there is something unsatisfying about this permanence of substance. For what counts, in life, is not the substance, but the form. And the form is fleeting, though the substance abide. What if the changing seasons leave the total mass and energy of the universe unaltered? Spring brings its buds and blossoms, Summer ripens, Autumn gathers in the fruit. These are the things that matter. What comfort, when the living form is fled, that the total substance be unaltered? Life is one ceaseless endeavor to preserve a form, an effort in which sooner or later all are vanquished.

Yet, for a time the organism does succeed in preserving that characteristic form on which its life, its consciousness depend. And, strangely enough, here, in a sense, conditions seem reversed: while the form is constant, the substance is forever changing. The human body, for example, might be likened to a house, the bricks of which were continually being removed and replaced by others, in such way that the form of the building be carefully preserved. The life of man, his very identity, depend, not on the bricks of which he is built (for they are replaced from day to day), but on the form in which his structure is raised. And this constancy of form, which for a time is his, unlike the constancy of mass, is not inherent in the nature of things, but must be purchased by continued effort. And sooner or later the effort fails, and that form which means all to the organism crumbles and decays.

As if by an irony of fate, while Nature has guaranteed the permanence of substance, at any rate for eons to come, the very things by which we set most store depend on form, fleeting, evanescent.

Electricity

Buying Current for Electric Railways.—At a recent meeting of the Illinois Electric Railway Association in Chicago, Mr. Peter Junkersfeld gave an address on power production for electric railways, in which he brought out the fact that while in 1902 electric railways purchased very little power, ten years later 33 per cent of all the power used was purchased. Illinois, in 1912, purchased electricity amounting to 58 per cent, while in Chicago, during the first few months of the present year, surface and elevated railways used 90 per cent of purchased electrical energy. This shows that electric service companies, by producing in large quantities and specializing, are able to furnish electricity cheaper than the railways can manufacture it for themselves.

New Lights for Turin.—The city of Turin is occupied with the task of reorganizing the public lighting on a modern basis, and no less than $400,000 will be employed for this purpose, the work to be carried out from 1914 to 1916. According to the plans, arc lamps will be used in all the main streets and avenues, also the public squares, while smaller streets are to be lighted by incandescent lamps. Flaming arcs in closed globes will be used. About 3,000 lamps of 2,000 candle-power each will be installed. In some places, incandescent lamps are used, some being of the 500 candle-power type, and the rest of 100 or 200 candle-power. These are much better than the present gas lamps, which give only 50 candle-power. Current for the whole system comes from the municipal electric station.

Hydro-Electric Plant for Washington.—A bill has been introduced in the Senate providing for the development of electric power from the Potomac River at Washington. According to the plan, the Potomac River is to be dammed at the Chain Bridge, just above Washington. The dam is to be 115 feet high, and would make a lake 9 miles long, extending as far as Great Falls, where the city now obtains its water supply. The plant would develop 99,000 horse-power. The Government now uses a steam plant producing 10,000 horse-power, and about 1,000 horse-power more is bought from an electric power company. With its own power plant, the Government could obtain all the electricity it needed at a much lower cost, and would have, in addition, plenty of current to sell at a low rate to railways and factories.

First Prosecution for Violation of Wireless Laws.—A wireless amateur of Los Angeles was reported to the United States Attorney for operating his station without a license, and causing interference, being a violation of Section 1 of the Act of August 13th, 1912, to regulate radio communication, for which a penalty of $500 is provided and the apparatus may be confiscated, in the discretion of the court. Judge Wellborn, of Los Angeles, in passing sentence upon the offender, stated that as this was the first prosecution under the law in his district, he would assess only a nominal fine, with the understanding that all future prosecutions under this Act would be dealt with summarily, and the punishment materially increased. In view of the fact that the offender had disposed of his radio apparatus shortly before his indictment, the judgment did not include the confiscation provided by law.

Look Out for the Wires!—The New Haven Railroad has issued a warning to all persons along the line of its present electrical extension, notifying them, and particularly the small boy, that the wires are soon to be charged. As a voltage of 11,000 is to be used, the wires are certainly not to be meddled with. At different points along the line there are circuit-breakers where sections of the road can be de-energized. In case of a fire where a stream of water might be directed against the wires, or any other emergency, word would be sent to the Cos Cob power house, and in five minutes that section of the line would be de-energized. While no harm can come merely from the spray occasioned by squirting at a fire, it would certainly be careless for the firemen to direct a stream full at the wires. About two thousand "Live Wires," "Danger" and "Keep Off" signs have been installed along the line.

The Most Powerful Magnet.—Probably the strongest electromagnet is produced on the new method which Profs. Perot and Deslandres are applying, with success. Their idea is to take one of the strong electromagnets of laboratory type with pointed pole-pieces which already give a high value of the magnetic field, and then to put an extra coil around the air-gap between the poles so as to add considerably to the field. Such coil is made of thin copper strip and is cooled down as low as —30 deg. Cent. by a current of oil, so that a remarkably heavy current can be put into the coil without burning it; for instance, it will stand a current density of 1,800 amperes per square millimeter, using a 0.2 millimeter strip. Such a coil is put on a Weiss electromagnet which carries the usual coils and gives 41,000 gauss for the magnetic field strength. Putting on the 30,000 ampere-turns of the new coil, this brought the field strength up to 51,000 gauss, and it was only lack of current supply that prevented running as high as probably 60,000 gauss, so that a most powerful field can be thus obtained.

Science

A Fine Collection of Meteorites has been acquired by the American Museum of Natural History, in New York, through the generosity of Mr. J. P. Morgan. This comprises the entire stock of meteorites which belonged to the unique establishment in Washington known as "Howell's Microcosm" at the time of Mr. Howell's death, and includes representatives of 54 falls, weighing in the aggregate about 220 pounds.

The Association of American Geographers at its last annual meeting adopted a plan of co-operation with the American Geographical Society, in accordance with which a joint research committee of the two organizations is to administer a joint research fund; a joint meeting of the two organizations is to be held in New York each Spring; the Association is to publish its annals in collaboration with the Society, and the two organizations will interchange publications.

Explorations North of Siberia will be resumed this Summer by Capt. (late Lieut.) Vilkitskii, who discovered last Summer a large and previously unknown land north of Cape Chelyuskin. He will have under his command the same vessels as last year, the "Taimyr" and "Vaigach," both of which are ice-breakers. The best of the several maps thus far published of Vilkitskii's discoveries appears in the April, 1914, number of *Petermanns Mitteilungen*.

Sir Ernest Shackleton, accompanied by five members of his prospective Antarctic expedition, will shortly make a practice trip over the Norwegian glaciers, in order to test under polar conditions his rations, tents, motor-sledges, and other items of outfit. The party will live on regular sledging rations, and the effects of these on the explorers will be carefully studied. The dogs which Shackleton will take with him to the Antarctic have been especially bred in arctic Canada, and are a cross between a wolf and a Scotch staghound. They are about twice as heavy as those which he used in his last expedition.

Arsenic in Carpets.—Arsenic in certain carpets was found to be the cause of hitherto undiscovered maladies in various cases noted by the German scientist, Dr. Küttner. It may appear singular that the presence of carpets should be detrimental to the health, but he observed five cases with distinct symptoms of anæmia and the like, and these disappeared when the carpets were removed. He surmised from the color that the carpets might contain arsenic, and when they were analyzed this was found to be true, and in a considerable proportion. Traces of arsenic were also found in the bodies of the persons.

The Proposed Swedish Antarctic Expedition has now, as appears from a detailed statement of its plans in the *Geographical Journal*, expanded into an "Anglo-Swedish" expedition. Funds toward the support of the enterprise are being raised in England. The trustees of the British Museum have promised an annual grant of $2,500 for five years, and the Royal Society has granted $2,500 for the first year. Two places on the staff of the expedition are to be reserved for English scientists, and the collections are to be divided between English and Swedish museums. It is planned to have the expedition leave Europe in August, 1915, and return in February, 1920

The Members of the Staff of Mount Rose Observatory, Nevada, have found shellac to be an impervious and pliable water-proofing for rubbers, which otherwise during a day's use on the snow-fields absorb sufficient moisture from the snow to dampen the feet. An application of the shellac at infrequent intervals kept the rubbers in perfect condition. It was also found that a coating of shellac on the thongs of snowshoes prevented them from becoming quickly water-soaked on wet snow, and so eliminated much of the sagging and heaviness that form a serious drawback to walking on webbed snowshoes over melting snow. Thongs coated with shellac also dried after becoming wet much more quickly than thongs uncoated.

The Tides of Hudson Bay were discussed by Dr. Bell Dawson in a recent lecture before the Royal Astronomical Society of Canada. This subject is becoming of much practical interest, in view of the increasing use of Hudson Bay as a highway of commerce, but comparatively few actual observations have been made. The most important were those of Ashe, Stupart, Tyrell, McKenzie and others in 1884–86, in various shallow regions of the bay and in Hudson Strait. From these observations, the types and ranges of the tides are known at various present and prospective ports, and by selecting a port in some other part of the world for which the type is similar and for which accurate tide-tables exist, it is possible to compute tables for any desired port. By this method, Dr Dawson has computed tables for Port Nelson, using the tables for Bremerhaven, Germany, as a standard—both places having tides of the estuary type, and the North Sea and Hudson Bay being similar offshoots of the North Atlantic. In the same way, the tide-tables of Harwich, Eng., have been used in the computations for Churchill; while the tides of St. John, N. B., have been harmonized with those of Hudson Strait observed in 1884–86.

Aeronautics

Gyratory Control in Flying Machines.—Patent No. 1,096,045, to Gustav Mees, of Charlottenburg, Germany, is for a flying machine in which use is made of a steering lifting propeller combined with a fly-wheel acting as a gyratory body.

The Aerodynamic Institute of Koutchino, in Russia, celebrated its tenth birthday on May 10th. This institution was founded by its present director, M. Riabouchinsky, and has made notable contributions to the development of aeronautics

An Armored Aerial Machine.—Paul Daimler, of Cannstatt, Germany, has patented an armored aerial machine, No 1,095,711, in which aim may be taken and a projectile fired in the direction of the propeller shaft without hindrance from or interference with the propeller.

A Bomb to Destroy Aircraft.—A patent, No 1,092,760, to Joseph A. Steinmetz of Philadelphia, Pa , furnishes means for destroying an airship by another higher ship through the aid of a drag line carried by the higher ship and suspending a bomb which is exploded by being drawn upward alongside of and against the lower ship

A Flying Machine Control Device.—William B Oliver, of Collingswood, N J , in a patent, No 1,096,263, provides means whereby he seeks to automatically maintain the normal equilibrium of a flying machine in a predetermined position or series of positions during flight, thus relieving the aviator from the necessity of constantly manipulating the regulating devices.

The Wright Licenses.—According to the daily press, Orville Wright and the directors of the Wright Company recently met in New York city to discuss the terms upon which fliers and builders of aeroplanes may use the Wright inventions. In order to discourage bad workmanship, it is stated that only responsible firms will be licensed

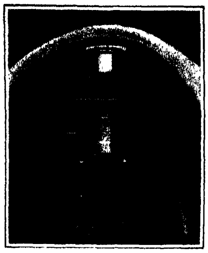
Using a Parachute for Elevating the Machine. In a patent, No. 1,093,788, V A Lamare, of Chicago, Ill , assignor of one half to Linwood F Jordan, of Portland, Me., shows a series of parachute reciprocating vertically in the frame of a machine with the upward and downward movement of the parachutes alternating to cause the ascent of the machine.

A Series of Flying Machine Patents.—James S. Lang, of Boston, Mass , has secured patents Nos 1,096,251 to 1,096,256, inclusive, the first four patents relating to gyroscopic controlling elements and some of the patents refer to the engine itself as the gyroscopic power, while patent No. 1,096,255 provides auxiliary planes at opposite sides of the machine and co-operating with the main plane for effecting a lateral control by varying the lifting efficiency of the main plane, and patent No 1,096,256 provides a special construction of one of the planes.

Military Aviation in the United States.—The United States Government intends to strengthen the aeronautical branch of the Army It is reported that an order for thirty aeroplanes has either actually been given, or will be given. According to Secretary of War Garrison, the army needs fliers badly The United States has made no systematic effort either to upbuild an air fleet at all comparable with the air fleets of Europe, or to train an aeronautic personnel The army aviation schools turn out but very few men.

Aviation in Japan.—Capt Tokugawa of the Japanese army, and an old pupil of Farman, has published an interesting article on the progress of aviation in his country For several centuries, the art of traveling in the air has been known to the Japanese, he claims In 1702, an ingenious bandit named Kakinoki Kinsuke invented an apparatus by means of which he was enabled to attain the roof of a building in Nagoya and rob it of certain gold ornaments As in Europe, aviation has become strictly military in Japan, the 25 aviators of Japan all belong to the army, which, up to the present, only possesses 15 aeroplanes, nearly all of which are of the Farman type Capt Tokugawa remarks that at small distances from the ground in Japan dangerous currents are constantly circulating, a fact which compels the Japanese aviators to fly always at a good height.

New Military Aeroplanes. At the military aerodrome of Doeberitz, Germany, trials are soon to be made with a mitrailleuse mounted on an aeroplane by the use of a turntable base so as to point the gun in all directions A special device is said to be employed so as to prevent the screw from being damaged by a projectile. The bottom of the aeroplane can also be opened up so as to allow of firing downward upon the ground On the other hand, we learn that the Admiralty has lately made very successful tests of a new hydro-aeroplane constructed by the Samuel White establishment. When carrying full load the speed was 75 miles an hour and it could rise from the water to 1,000 feet height in 2½ minutes. The flier is fitted with a Salmson motor of 200 horse-power size During the recent elimination flights which served to select fliers for the Swiss army, three types of aeroplane were qualified, namely, a Blériot and two German makes.

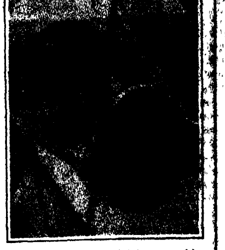


How the gun in the Vickers machine looks to the gunner.

Novelties in Aeroplane Design

A Sixty-Mile-an-Hour Gun-Carrying Biplane of Steel

A Flying Machine Which is a Mechanical Equivalent of a Soaring Bird



The gunner in the Vickers machine sits in front of the pilot.

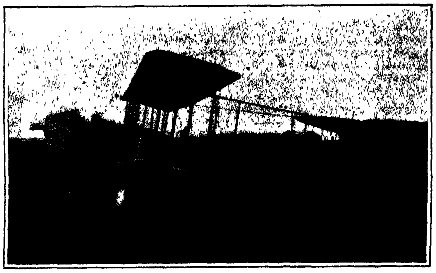
A Gun-carrying Biplane

By Major H. Bannerman-Phillips

UP to the present progress in aeronautics, from the military point of view, has been directed mainly toward obtaining the best possible method of aerial transport for purposes of reconnaissance, although the question of offense, by means of guns and dropped projectiles, has not been lost sight of, and many experiments have been made with both airships and aeroplanes, though with results which can hardly be called conclusive, in so far as they concern fighting in the air between aircraft. There are many who still hold that the business of the latter is scouting, and that, for the present at any rate, speed is more essential than ability to attack, since the fast light scout will have the advantage of the armed machine, which, having to carry a gunner besides guns and ammunition, is bound to be heavy and slow in pursuit, and will not be able to get within range of the fugitive, the single occupant of which will obtain all the information which it is possible for an overhead observer to get, in spite of threatened opposition.

Others again hold that the opposition of the fighting aeroplane will be effective to prevent other aircraft from prosecuting a successful reconnaissance, and that, if information is to be obtained, it will have to be fought for in the air.

The fighting aeroplane is being evolved to suit the latter view, and, although we have nothing definite, in the way of past experience, to go upon, it is none the less interesting to watch the evolution of the avowedly militant types of aircraft which are now being built, and which are especially designed to carry a gun, and one of these is the Vickers fighting biplane, which is shown in the accompanying illustrations It is designed for weight carrying and for a variable speed of from 40 to 70 miles per hour. The machine, so far as tests show up to date, has flown at speeds varying between 45 and 60 miles per hour Messrs Vickers, Limited, as a large armament firm, have every reason to know the value of steel in construction, and they have used it throughout in building this biplane, except as regards the main wing spars and two wooden struts in the landing carriage, the reason for this being that, although wood is not actually more elastic than steel, it will, in practice, bend to a greater extent and spring back again, without acquiring a permanent "set" In the later type of this machine, stabilizing flaps are used on the wings, instead of warping the whole wing. The gun is a small Vickers automatic gun, covered in front by a hemispherical shield, which is mounted on the barrel and moves with it The shield is provided with mica windows, to protect the gunner's eye from the draught of wind caused by the rapid movement of the machine through the air. The muzzle projects through the nose of the fuselage, which itself is entirely covered in, and is carried well forward of the wings. Those who understand the handling of such a gun will appreciate the fact that this is an ideal position for it, affording the utmost obtainable range of view and facility for traversing right and left, and for elevation and depression. This gun-position of course, involves the necessity for the biplane itself to be of the "pusher" and not of the "tractor" type.



The new Vickers gun-carrying biplane.

The requirements of the British military authorities are complied with, namely, that the machine gun shall have a clear field of fire in every direction up to 30 degrees from the line of flight, or, in other words, that the man behind the gun should be able to fire directly ahead within an arc of 60 degrees.

Analytical Comparison of the Bird and Monoplane

By James F. Blanchard, D.O., M.D.

FROM the dawn of time man's greatest desire has been to follow the birds through space; but not until the present gasoline motor made its appearance has that longing been realized.

If the minds that developed these wonderful machines which carry us through the air like the birds had kept away from the box-kite idea and followed more closely the anatomy of our feathered friends, the writer (who, by the way, is a physician, but one who has spent considerable time along mechanical lines) believes that more rapid progress would have been made in both pleasure and commercial air-craft.

His interest was greatly stimulated along these lines while spending a winter in Florida, several years ago. The birds of that part particularly interested him, and from these came his inspiration to build more closely along Nature's lines. The gull furnished him with the thought for the water plane, and the buzzard the idea of the land craft. His experience with the anatomy and physiology of these creatures he applied to his experiment, and the results were very gratifying.

After months of exhaustive investigation it was found that the structure of the present-day machines was weak and contrary to the laws of Nature as represented by the original denizens of the air.

It was plain to see that the mechanical bird, to be a success, must be a duplicate of Nature's air-craft, and in order that success shall be obtained, the principles of physiology and anatomy must be applied to this structure.

Pressed steel in suitable form is substituted for the bony structure of the bird. This forms the fuselage, rear appendages, main planes, and landing chassis. Trussing of light steel-tubing and laminated wood give a fine substitute for muscles, tendons, and ligaments. Fireproof cloth, sheet steel, and aluminium take the place of skin and feathers. The motor and radiator are substituted for heart and lungs; water, gasoline, and the oiling system for the lymphatics and vascular system; steering-wheel and controls for the nervous system. The special senses are represented by searchlights, wireless, and an efficient aviator. The flexor surfaces of the wings and tail-appendages are strengthened proportionally to extensor surface, according to the functions they have to perform. In this construction, strength and lightness are

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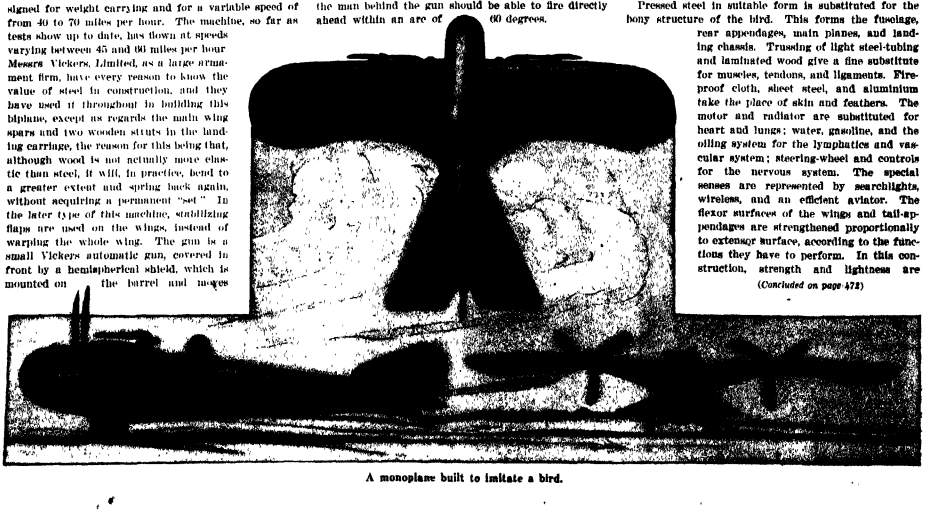
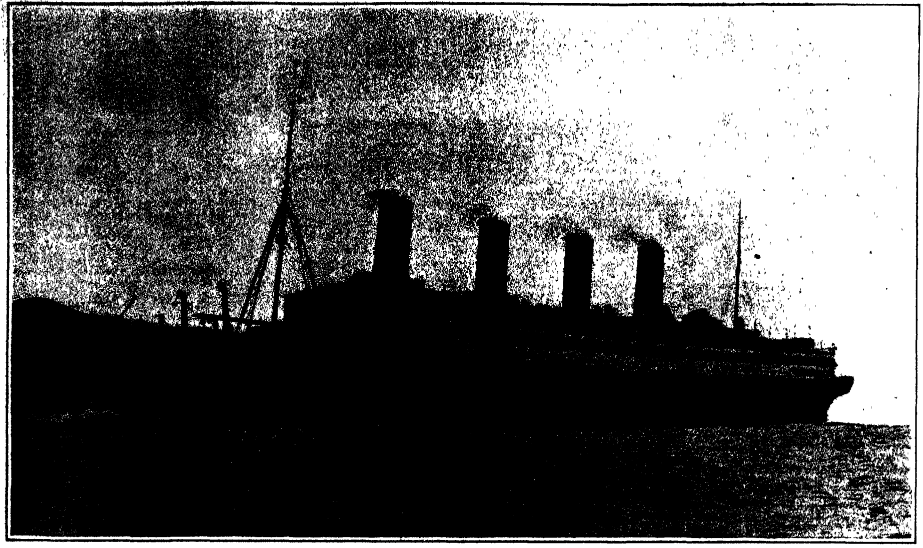


A monoplane built to imitate a bird.



Length, 901 feet; beam, 97 feet; depth, 92 feet. Gross tonnage, 47,000 tons Displacement, at 36 feet draft, 53,000 tons.

The new Cunarder "Aquitania."

The New Cunarder "Aquitania"

Another Ocean Liner Over 900 Feet Long Reaches the Port of New York

RESIDENTS of the port of New York are receiving dramatic evidence, these days, of the growth of the transatlantic steamship. In our issue of two weeks ago we illustrated the second of the great ocean liners to exceed 900 feet in length, the "Vaterland;" this week we present illustrations of the latest ship of this type, the "Aquitania," whose length of deck is 901 feet. As one contemplates the truly enormous dimensions of these vessels, reads the statistics of their cost of construction and operation, and takes a stroll through the vast halls, lounging rooms, and promenade spaces, the question inevitably arises: how can such costly ventures be made to return any dividend on the investment? The answer is to be found partly in the economic fact that the larger the ship, the less the cost of carrying a ton of freight or a given number of passengers, and partly in the fact that the possession of these wonderful ships enhances the reputation of the steamship company and so, indirectly, brings revenue into the treasury.

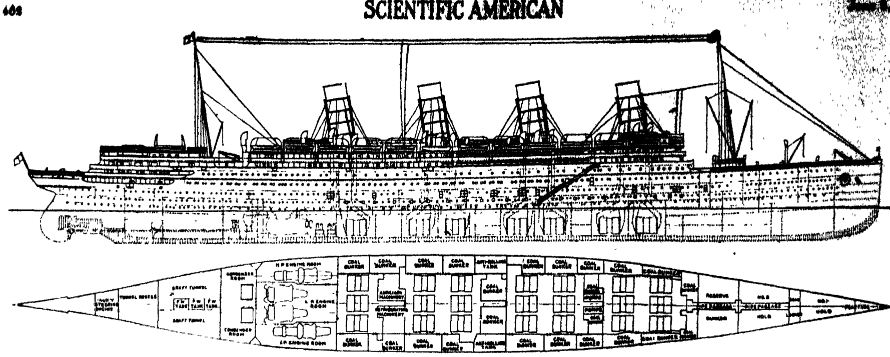
The "Aquitania," which was built at Clydebank, is exactly 901 feet long on deck, 97 feet broad, 92 feet deep to the boat deck, and has a gross tonnage of 47,000 tons and accommodations for between four and five thousand persons. It is an interesting historical fact that, a little more than a century ago, the same waters into which the "Aquitania" was launched witnessed the launch of the pioneer steamship in European waters--Bell's "Comet," which was launched in 1812. This tiny vessel was 42 feet long, 11 feet broad, and 5½ feet deep. It was a few years earlier that Fulton sent the "Clermont" on her maiden trip from New York to Albany and back on the Hudson River.

The "Aquitania," which is considerably the largest ship of the Cunard Line, naturally invites comparison with those two famous boats, the "Lusitania" and "Mauretania." Comparing her with the "Mauretania," we find that she is considerably larger, having a displacement of 53,000 tons on a draft of 36 feet, as against the "Mauretania's" 41,550 tons on a draft of 36 feet 2½ inches. Her horse-power and speed, however, are considerably less, the "Mauretania" having maintained an average speed of 26.06 knots across the Atlantic, with a shaft horse-power of about 74,000, whereas the "Aquitania" was designed to make 23 knots with 56,000 horse-power. However, it should be stated that, during her trial trip, previous to leaving for New York, she made considerably over 24 knots, with a proportionate increase in horse-power, without having her boiler plant pushed to the full limit. The "Mauretania" is 790 feet long on deck, 87 feet 6 inches in beam, and she has a molded depth of 60 feet 6 inches, as against a molded depth of 64 feet 6 inches in the "Aquitania." The gross tonnage of the "Aquitania" is 47,000 and of the "Mauretania" 30,704 tons. The hull of the "Aquitania" weighs 29,150 tons, and the machinery 9,000 tons, as against 19,758 tons' weight of hull in the "Mauretania" and a weight of machinery of 9,402 tons The "Aquitania" carries 6,000 tons of coal in her bunkers, and the "Mauretania" 6,354 tons The "Aquitania" has provisions and accommodations for 618 first-class, 614 second-class, 1,998 third-class passengers, and a crew of 972, making a total of 4,202 persons, as against the total number of persons carried on the "Mauretania" of 3,000 It may be mentioned that these figures were given by the designer of the ship, Mr. L. Peskett, in a paper read recently before the Institution of Naval Architects They are of great interest, as showing that to secure the additional three knots of speed the smaller "Mauretania" requires a greater weight of machinery than the "Aquitania."

Before passing on to further description of the technical features of the ship, mention should be made of those decorative features which form such an impor-

The first-class smoking room.

The restaurant.



Outboard profile and hold plan of the "Aquitania."

tant element of attractiveness in these great ocean liners. The scheme of internal decoration of the "Aquitania" tells the traveler the history of the nation from the far-off days when that "goodlie ship The *Great Harry*" was one of the world's wonders down to the end of Europe's struggles for supremacy with Napoleon, the period in which Fulton in America and Bell in Great Britain introduced the steamship to their respective countries. The sculptor, the painter, and the engraver have been requisitioned for this work, and the ship is full of rich samples of their work. Among the features provided for the recreation of the passengers may be mentioned the long gallery, which reaches for about 150 feet, and the garden lounge, extending for an equal distance. In the latter, sheltered from wind and weather, with an outlook toward the sea, the treatment is suggestive of an old English garden, the walls of the deck house on one side of the lounge having been treated to represent stone covered with trellis in natural teak. The ship has a large gymnasium and a swimming tank with a depth of 7½ feet.

Construction of the Hull.—There is a double bottom, extending entirely from stem to stern, generally 5 feet 4 inches deep, but increased to 6 feet 3 inches at the turbine room. In this double bottom are forty-one watertight compartments. The central longitudinal girder is built of plates over one inch thick, and this, with two other fore-and-aft girders on each side of it, are solid and watertight. The side framing is of steel channels, with webbed frames 36 inches deep introduced at every third frame throughout the greater part of the length of the ship. All of these extend to a deck 10 feet above the load water-line, and some to decks above this level. The shell plating is 23/20 of an inch thick amidships, the four sheer-strakes being doubled.

Subdivision.—The hull is divided into eighty-four compartments in addition to the forty-one compartments in the double bottom. There are sixteen transverse bulkheads, most of which extend to 19 feet above the load water-line. The turbine room is divided into three compartments by two longitudinal bulkheads, and there is a centerline bulkhead running through the room containing the condensing plant. Eighteen feet in from the outer skin of the ship, on each side, are longitudinal bulkheads forming the inner walls of the bunkers. These extend throughout the machinery and boiler spaces and afford an inner skin to prevent the inrush of water, in case of accident, into the boiler spaces. The hatches to the cargo hold are trunked and made watertight to the weather deck. In her construction the ship may be considered as a box girder formed by the double bottom and the side framing and shell plating, the top of the girder being what is known as B deck, 73 feet from the keel-plate. The shell plating is doubled for a height of 12 feet at the gunwale. For the remaining part of the girder this deck is single-plated. Fore and aft of the machinery spaces is a partial deck, making six within the molded structure of the ship, and there are three superstructure decks above this, making nine in all.

The "Aquitania" carriers 80 large lifeboats, including two motorboats, which are described elsewhere in this issue. For clearing the ship of water, in the event of flooding consequent on collision, pumping arrangements have been provided for dealing with about 16,000 tons of water per hour.

The boiler plant consists of twenty-one, large, double-ended boilers, capable of converting 9,000 tons of water into steam per day. They are operated under a pressure of 195 pounds to the square inch. The ship has four elliptical funnels measuring 24 feet by 17 feet in diameter, and the distance from the top of the funnel to the level of the fire grate in the boiler room is 160 feet.

The turbines are directly coupled to the propellers, and there are four in all, placed in separate watertight compartments. They are operated on the triple-compound system, which gives a great range of expansion to the steam, with consequent high economy. The condensers are filled with 18,700 tubes, which, if placed end to end, would extend for 50 miles, and through the condensers 12,500 tons of water pass per hour for the condensation of the steam. There are over 1,000,000 blades in the turbines, which vary in height from 1½ to 20 inches.

The "Aquitania" has the same beautiful contour and well-balanced position of masts, funnels, deck-houses, etc., which characterizes the "Lusitania" and "Mauretania."

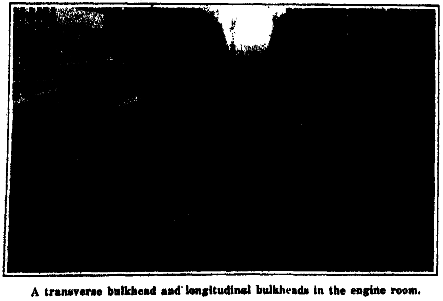
Testing the Langley Aeroplane at the Curtiss Aerodrome

By Our Staff Correspondent at Hammondsport

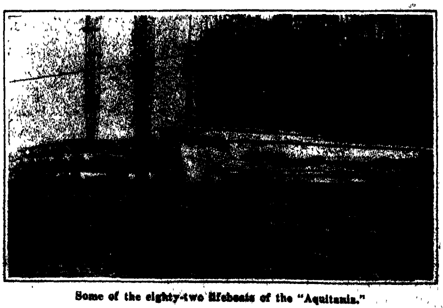
As this goes to press, Mr. Glenn H. Curtiss is on the point of launching the large Langley aeroplane at his aerodrome on the shore of Lake Keuka. The machine and its engine had been shipped from the Smithsonian Institution to the Curtiss factory early in April, and was reclothed without change of size or shape. The framing, the engine, propellers, wings, rudders, and controls are, therefore, just as Langley left them. A modern radiator and carbureter are used, and the whole aeroplane is mounted on three floats, so as to rise from the water. In this way over 200 pounds' extra weight and considerable air resistance have been added to the original machine. With the lowered mass center and lowered line of resistance, the craft is really less steady than the original; yet it is expected to navigate without presenting aerodynamic difficulties. The practical aviators expect it to succeed on the first launching.

For some weeks past the aeroplane has been in the process of re-covering, assembling, taking on floats, and the framework that joins them to the original frame. The whole was suspended by four parallel ropes, as in Langley's day, from the ceiling of the workshop, and moored to the wall by a spring balance attached to its tail. The engine, of some 50 horse-power, set the twin propellers, of 8 feet diameter and 8 feet pitch, whirling at over 600 revolutions per minute, and registered a thrust of 300 to 400 pounds. In the open air, it is expected, the thrust will exceed 400 pounds. This thrust should easily sustain the 830 pounds original weight of the machine, plus the 200, or a little more, due to the hydroaeroplane floats and the trussing above them. As the total wing area equals 1,024 square feet, the whole should lift at a speed neighboring 25 miles an hour.

On the evening of May 28th, the aeroplane, minus wings and tail, was transported to the Curtiss aerodrome, placed on the beach, and adjusted for a preliminary skim on the surface of the lake. A thunderstorm blew up and raged till midnight. Next forenoon the wingless craft was carried from the hangar, set on the water, and started, with Mr. Curtiss as pilot in the little canoe-shaped seat where Manly sat in 1903, when he was shot so heroically into space from the top of the house-boat, then headlong beneath the Potomac waters. Langley's successor and friend, Secretary Walcott of the Smithsonian Institution, now stood near, a complacent and smiling spectator. About him was a little army of aviators and assistants; at his elbow stood his daughter, the keenest spectator of all. The cameras began to click, the craft shot over the water at a 40-mile pace, skimming like a stone, and almost leaping into the air. The small vertical air rudder under the rear center of the frame had not purchase enough to enable Curtiss to turn promptly on the water; so he stopped his engine nearly a quarter of a mile from shore, and allowed a motor-boat to tow him home without delay.



A transverse bulkhead and longitudinal bulkheads in the engine room.



Some of the eighty-two lifeboats of the "Aquitania."

This picturesque and successful run inspired everyone with the belief that, with the wings added, the craft would take to the air well enough to satisfy a moving-picture artist. Some final adjustment was now made in the bevel-gears connecting the engine and propeller shafts, and announcement was made that the real launching would follow presently, if the weather permitted; for heavy clouds were gathering, and it was very moist and hot. An hour later a furious thunder-squall broke over the aerodrome, and the men laughingly remarked that the demons of the air still rage at Langley's invention, and want to destroy his machine.

As the sky threatened during the rest of the day, Mr. Curtiss postponed the launching till the next morning. At sunrise on May 28th, the workmen began fixing the wings on the frame beside the lake, and at six o'clock all was ready. Though the clear sky and mildly moving air seemed most inviting, Mr. Curtiss hesitated to launch, owing to the streaked condition of the water, which indicated a puffy and treacherous air. At seven he took the pilot's wheel, headed in the direction from which the wind appeared to come, and skimmed over the water under full power. The motion was most stately and dignified, but the craft stubbornly veered to port, while Curtiss tried to steer straight ahead with the little vertical rudder. The great tail automatically headed her into the wind from the port side. Presently she rose on even keel, without pitching or rocking, and sailed toward the beach. Mr. Curtiss, erroneously thinking the left side had too much resistance, shut off the power, and was towed back to the hangar. Unfortunately, neither the photographer nor the moving camera man caught the craft in the air. A second launching, after breakfast, terminated prematurely by the giving way of one bearing of the port propeller shaft near the bevel gear, entailing some hours delay for repairs.

Langley's creation is the favorite machine in the factory, even when compared with the transatlantic flier which is building in the neighboring room. The mechanics express astonishment at the perfection of design and workmanship displayed in every part of the old Langley structure. They have been working long hours overtime, for many days, yet each mechanician is as keenly interested and enthusiastic as if the machine were his own. The propulsion plant they regard as a marvel for that early day, 1903—five years before the beginning of public flights in this country and Europe. The brief successful flight of May 28th proved Langley's invention to have been the first machine in history capable of prolonged free flight with a passenger. A great scientist and inventor, misunderstood and persecuted in his lifetime, is vindicated.

The Bachelet Railway

THE Bachelet Railway, with which readers of the SCIENTIFIC AMERICAN are doubtless familiar, since the invention was described in these columns many months ago, has caused some stir in England. Bachelet recently exhibited there the miniature prototype of a 300-mile an hour train. Yet Englishmen, while astonished at the performances of the model, were not blinded, as the following excerpt from the *Manchester Guardian* shows

"First," remarks our contemporary, "it is an electric railway; but instead of rotary electric motors in the coaches, there are large electromagnets encircling the track at regular intervals, whose function it is to pull the train or coach along, automatic switch-gear cutting in and out each solenoid at the right moment. That this is easily workable for a small model and quite practicable for a full-sized railway is obvious enough; but on the face of it it should be far from economical, even if each solenoid is energized only while a coach is actually within its tunnel, and the air-gap reduced to a minimum. Taking this economical precaution would mean that the coach has to carry in one form or another an armature sufficiently heavy to give the required average pull, though attracted only for a comparatively short proportion of the time occupied by the whole run. As against this—or, at least, one may so consider, though the published accounts do not say so—is the second great feature of supporting the train magnetically in the air. This gets rid entirely of the ordinary rail and journal friction, and so the train might be made as heavy as its peculiar method of propulsion called for without any increased frictional loss, so long as the size or shape was not altered to increase the wind resistance. This alone, under the best conditions, would be enormous at 300 miles an hour; but that is not a greater argument against the Bachelet railway than against any other kind of locomotion at that speed.

"As to the exact method of supporting the coaches we have not much information; but we surmise that the physics of it are nothing more novel than electromagnetic repulsion. When a coil of wire having no self-inductance is placed in an alternating magnetic field, so that the lines of force pass through its turns, an alternating E. M. F. is set up in it at 90 degrees in phase behind the magnetic flux, and, the resultant current in the coil being in quadrature with the flux, the forces between magnet and coil cancel out to zero. The coil, therefore, would make no effort to move. But the ideal of no self-inductance is unattainable in a coil or even in a flat disk (such as M. Bachelet appears to have used to impress his methods on the minds of journalists and others), and, as a result, the current lags by more than 90 degrees behind the magnetism, and the repulsion force predominates to that extent. All this, so far from being new, was stated and explained by Prof. Elihu Thompson long ago, and is the basis of the repulsion motor, which is wasteful, heavy, and expensive. By using a powerful alternating current magnet with, preferably, a high frequency, metal rings and disks of considerable weight may be supported and flung up in the air; and the lower the resistance the greater the effect, because the induced current is greater. Hence, presumably, the disk form. There is reference in the newspaper accounts to other auxiliary apparatus, but too vague to disclose whether this apparatus is calculated materially to improve the economic efficiency of this method of supporting a train. Unless it does, the Bachelet railway's chief claim on the future historian may be that Mr. Winston Churchill went to see it."

The Death of Sir Joseph Swan

SIR JOSEPH WILSON SWAN, inventor of the first incandescent electric lamp, died on May 27th at the age of eighty-six.

Although years of patent litigation have upheld Edison's right to be regarded as the inventor of the carbon incandescent lamp, there can be no doubt that Swan was entitled to a place among the first two or three who gave to the world the present incandescent lighting system. He early showed a marked bent for scientific pursuits, and was accordingly apprenticed to a chemist in his native town. Thence he went to Newcastle, where he was employed in a large house of manufacturing chemists, in which he became in time a partner.

As a manufacturer, Swan was engaged in the production, among many other things, of photographic plates. The dry plates of that time were slow, and instantaneous photography was impossible. Swan experimented, with the purpose of increasing the sensitiveness and rapidity of the plates, and eventually produced the first really rapid dry plates A valuable pendant to this great achievement was his subsequent invention of carbon printing in photography.

As early as 1860 Swan became convinced that for most purposes the incandescence of a filament, probably of carbon, would be the most practicable source of illumination.

His first electric lamp had a carbon filament which he made by packing a strip of thin cardboard with powdered charcoal in a crucible and subjecting it to intense heat. This was placed in a glass bulb from which the air was exhausted, and an electric current was applied. It will be observed that this was practically the same method that Edison employed in his early operations at Menlo Park in the late '70s. Swan secured his current from a battery of Grove cells, which was not sufficiently powerful to cause complete incandescence, though the filament was heated red hot.

In 1879-1880 Edison gave his first exhibition of electric lighting at Menlo Park, with filaments of paper or bamboo carbonized through intense heat Late in 1880 Swan gave, at Newcastle, his first public exhibition of incandescent electric lighting on a large scale, using in his lamps filaments of cotton thread "parchmentized" by the action of sulphuric acid.

Another successful filament was made by him by squirting a jet of collodion into a coagulating solution, and then carbonizing by means of heat the tough thread thus produced. This process in modified form supplanted the Edison carbonized bamboo filament both in America and Europe.

The Current Supplement

IN this week's issue, No. 2005, of our SUPPLEMENT, H Onslow gives some interesting facts regarding the structure and composition of hairs and hair pigments. —The second Wright Memorial Lecture was delivered this year before the Royal United Service Institution by Dr. R. T. Glazebrook, the director of the National Physical Laboratory, London, England. It deals with the services rendered to aeronautics by experimental research, and is reproduced in full in our current issue. —Prof. H. Payne writes on insulation for cold storage.—Dr. M. Philippot contributes an article on legal time in various countries.—J. A. Seager describes one of the most important iron works in Austria.—M. Longridge analyses the various causes of breakdowns in stationary engines.—Dr. Eccles' review of recent patents in radio-telegraphy is continued, and will be concluded in our next issue.

Washington stands first in lumber production, with Louisiana second.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Misinterpreted Wireless Signals

To the Editor of the SCIENTIFIC AMERICAN:

In the correspondence column of the SCIENTIFIC AMERICAN dated May 16th, 1914, under "Wireless Distress Signals," the writer states that the signal S O S is quite dissimilar to M B S, but, to my way of thinking, the combination of M B S could more easily be mistaken for S O S than any other combination of letters.

If the operator at the receiving station puts the receivers on his head in the middle of the call M B S and the call is not properly spaced, as most calling is not, due to the loss of time, etc., it is a very easy matter to mistake the call and read it S O S, which it would make if the operator at the receiving station took the S to be the first character of the call.

This undoubtedly was the cause of the false S O S on the part of the receiving operator, and the reason the false reports were not stopped by the operator on the "Siberia" was due to the fact that he was out of receiving range of the shore station.

I believe it would be impossible to have any definite tone for distress calls, due to the fact that there are all the tones possible to produce by the different spark gaps and systems now in use To have a definite tone and keep it uniform on all sets would be an endless undertaking due to voltage fluctuation, damp condensers, and numerous causes R. W WILEY

San Francisco, Cal

Nomenclature of Food Values

To the Editor of the SCIENTIFIC AMERICAN

Food values seem now, according to the current literature, to be classed as "energizers," "calories," "units of energy," "heat-giving qualities," etc, etc, little being said about the upbuilders.

The human body is an engine of flesh and blood and, of course, food keeps the engine going, and it is frequently popularly regarded as of steam propelling force value only We put coal in the furnace and about one seventh of its energy is passed on to the engine, the balance goes up the chimney This steam keeps the engine going, but the moment wear and tear, erosion, friction, etc, impairing the brasses, causing the cylinder to wear or the crank-shaft to need repairing, etc., the steam having no upkeeping, building, repairing influence whatever, trouble results. If the mechanic be not called in, no matter how much steam the gauge on the boiler shows, the engine rocks, pounds, runs down, and the steam becomes of no value The engine stops, because it is out of repair, and demands that new parts either be supplied or other worn deficiencies be made whole

And this is where the mechanical properties of the two bodies, the steam engine and the human engine, differ, as to energy influences.

Butter has two and a half times the energizing power of, say, lean meat or the casein of milk, the moisture being equal. Theoretically, on a full meal of butter or olive oil, we should be able to do two and a half times the work that a full meal of meat, or beans, or bread would produce. Butter would be a highly energizing food for the body, but prove worthless as an upbuilder, a repairer of the waste constantly going on with every breath inhaled—exhaled because of its lack of protein content. The same rule holds good with starch and sugar, carbohydrates, heat-givers or producers But in valuing up foods, whether all protein (building) or partly protein and partly fat and carbohydrates, the *energizing* value of the food only seems to be the index The protein is also an energizer, lean steak having, presumably, on an average, 950 units of energy to the pound Macaroni, the genuine American made article from our northwestern-grown Autumn wheat, so rich in gluten and natural sugar, "macaroni wheat," is credited with 1,650 calories of energy

But lean meat is, ex the moisture, almost wholly protein, while in macaroni, containing from 12 to 14 per cent of protein, the balance is made up of carbohydrates, starch and sugar, and for that reason one could keep in better health on a protracted diet of macaroni than on lean meat There is an approximate food balance in macaroni, but no balance in the lean of meat Potatoes, with a credit of 295 calories energy, contain but 1 8/10 per cent protein, while lettuce, with but 65 calories, has but 1 per cent protein

So it would seem that when food values are expressed in energies, reference should invariably be made to the upbuilding as well as the heat-giving values There is more, therefore, than the energy values in food, and whether the proteins are properly balanced with the carbohydrates and fats is of grave moment, indeed

Point Loma, Cal. CHARLES CRISTADORO.

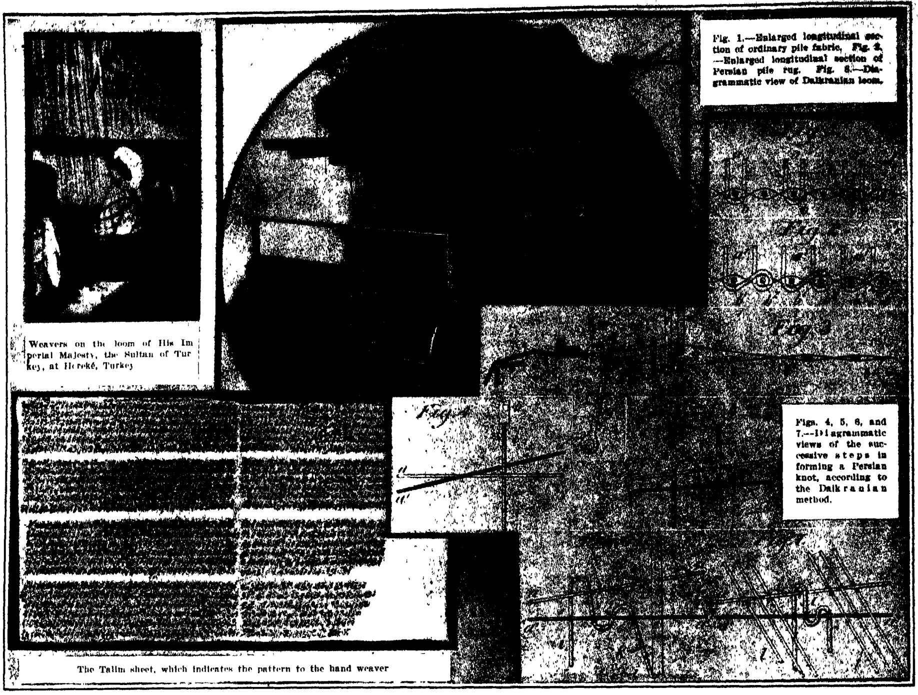


Fig. 1.—Enlarged longitudinal section of ordinary pile fabric. Fig. 2.—Enlarged longitudinal section of Persian pile rug. Fig. 3.—Diagrammatic view of Dalkranian loom.

Weavers on the loom of His Imperial Majesty, the Sultan of Turkey, at Hereké, Turkey

Figs. 4, 5, 6, and 7.—Diagrammatic views of the successive steps in forming a Persian knot, according to the Dalkranian method.

The Talim sheet, which indicates the pattern to the hand weaver

A loom that weaves Persian rugs with the characteristic Persian knot.

Weaving Real Persian Rugs on a Power Loom

An Interesting Solution of a Difficult Mechanical Problem

By Theodore G. Hoster

FOR centuries the hand-woven Oriental rugs, and notably the Persian pile rugs, that is, rugs having a pile formed by Persian or Sehna knots, have been admired the world over for their beauty in design and color blending, and prized for their durability Many attempts have been made by inventors to weave a Persian rug on a power loom to supersede the tedious process of hand-knotting as practised by the Oriental weavers The attempts have failed, because the ordinary power loom for weaving carpets and rugs can weave only in a forward direction, while for making a Persian or Sehna knot, a partial return weaving motion is apparently required

This can best be explained by references to Figs. 1 and 2, of which Fig 1 illustrates an ordinary pile fabric having each pile *a* looped around a single warp or a weft *b*, and Fig 2 shows a Persian rug having the pile thread *a'* passing under one warp *b'*, then up between the warps *b*¹ and *b*², completely around the warp *b*², and up between the two warps, *b*¹, *b*² It will be noticed that the full loop around the warp *b*² requires a backward movement, and this the ordinary power loom cannot do As a matter of fact, it has been considered by experienced weavers an impossibility to make the Persian or Sehna knot, shown in Fig 2, successfully on a power loom. The durability of the weave of the Oriental pile rug over the ordinary pile carpet or rug, considering the pile material to be alike, can be readily demonstrated by reference to Figs. 1 and 2 A pull exerted on either pile end of the knot shown in Fig. 1 draws the pile out of the body of the fabric, while a pull exerted on either pile end of the Persian knot, shown in Fig. 2, draws the knot tighter For this reason it is not necessary to use extra binding threads to hold the Persian knots in place in the weave, as is required in pile fabrics having the pile threads shown in Fig. 1.

Let us now briefly describe the weaving of an Oriental rug by hand In weaving, or, rather, knotting a Persian rug, the Oriental weavers are squatted in front of a vertically disposed warp depending from an overhead warp beam, as depicted in one of our illustrations. Each weaver, with his or her fingers, deftly ties a knot on a pair of warps (as shown in Fig. 2), the yarn used corresponding in color with this particular part of the design Next the weaver ties another knot alongside the previous one, on the following two warps. This knotting process is repeated until the weaver reaches the beginning of the row of knots made by his neighbor. Each weaver has a range of about two feet, in a horizontal direction. To tie a single Persian knot requires five distinct finger motions. After a row of knots has been completed a tying weft is threaded on the warp, and the knots and weft are beaten home. The balls of differently colored yarns for the knots are suspended from above, and the weaver cuts off the yarn after each knot is made. In front of each weaver and attached to the warps, a distance above the working row of knots, is a slip of paper (known as the *talim* sheet), which contains the instructions as to the color of the yarns to be used for each knot in each row of knots These instructions are compiled by special writers from the original design made by a draftsman, but some weavers are skilled enough to evolve a design while weaving a rug, that is, follow their own intuition and produce rugs marvelous in color blending and figuration. The piles are, naturally, of unequal length, and after the rug is woven the pile is sheared to uniform length. That the painstaking Oriental weavers, with the crude means at their command, have been able to produce the wonderful rugs so well known to us all, is truly marvelous.

Although the weave of Oriental rugs has been well known in Europe and America for centuries, although the power loom of Cartwright has been in use since 1784, and although the Jacquard machine for mechanically reproducing the most intricate patterns has been in action since 1801, it remained for an Armenian inventor, James Karmi Dalkranian, of New York, to devise a loom for weaving an Oriental pile fabric having true Persian knots.

In order to accomplish this result, Mr. Dalkranian had to strike out on entirely new lines, which we will endeavor to make clear to the reader by reference to the diagrammatic Figs. 3, 4, 5, 6, and 7. In the loom the warp threads are stretched in pairs *a*, *a*¹ from the warp beam *b* to the fell of the fabric at the breast beam *c*, and are controlled up and down by heddles *d*, *d*¹ for periodically opening the shed for the introduction of the wefts or binding threads. Next to the heddles *d*, *d*¹ is a fixed reed *e* through which pass the warp threads, which receive a sidewise motion by shogging combs *f*, *f*¹ to permit of alternately crossing the normally parallel warp threads *a*, *a*¹ and returning them to parallel position between the reed *e* and the fell of the fabric. Next to the shogging combs *f*, *f*¹ is the intermittently reciprocating lay *g* for beating in the knots and the weft. A tuft yarn tube *h* having an up-and-down and a forward-and-backward movement is used for each pair of warp threads *a*, *a*¹ to tie a pile thread *i* of a particular color to the pair of warp threads *a*, *a*¹, and this tuft yarn tube *h* operates closely to the fell of the fabric and in front of the lay *g* whenever the latter is in rearmost inactive position. The movements of the several parts is controlled in the proper sequence by suitable mechanism driven from a main power-shaft. During the working of the loom the shogging combs *f*, *f*¹ alternately cross a pair of normally parallel warp threads *a*¹ and then return them to parallel position, and during this time the tuft yarn tube *h* passes twice between the warp threads *a*, *a*¹, once while the warp threads *a*, *a*¹ are in the crossed position, and once while they are in the parallel position.

Fig. 4 shows the warp threads *a*, *a*¹ crossed and the tuft yarn tube *h* returned to uppermost position after its first descent between the warp threads *a*, *a*¹, so that

(Concluded on page 472.)

A "Varsity" Electrical Show

AN electrical show was recently held at the Ohio State University which proved an unqualified success. It was given by an enterprising association of one hundred young men, constituting the Ohio State University Branch of the American Institute of Mechanical Engineers. A string of lights from the University entrance to the Electrical Building, an immense "Electrical Show" sign, an electric waving American flag, a string of arc lights about the eaves of the Electrical Building, and a large searchlight mounted upon the building, made known to passers-by that the Electrical Show was on. The show was divided into two parts, one devoted to the exposition of commercial appliances, while the other related more particularly to demonstrations of curious and novel electrical effects, such as experiments with high-tension high-frequency currents, frying eggs on ice with the aid of eddy current, demonstrations of wireless telegraph apparatus, the singing arc, the loud-speaking telephone, and the like. Local electrical manufacturers supported the show with exhibitions of apparatus. Altogether there were about forty exhibitors in that section. The fact that the receipts were three times as much as the expenses may be taken as a measure of the success of the show. All the standard features of an electrical show, such as given in New York or Chicago, were to be found on a smaller scale at this exposition.

A Gasoline Switching Engine

By Our Berlin Correspondent

THE odd little piece of mechanism tucked under the end of a freight car in the accompanying photograph is a 20 horse-power switching engine, designed by a German firm. To insure the necessary traction the "locomotor," as the little switching engine is called, is furnished with a jack which is operated to lift the platform of the freight car, thus increasing the weight on the tractor wheels, and hence their adhesion to the rails The jack is also fitted with means for coupling the locomotor to the car.

The chassis is made up of substantial angle and channel irons and rests on two sets of steel wheels running in roller bearings. It is so designed as to insure perfect protection as well as an easy access to all the main interior parts—motor, carbureter, radiator, fuel tank, gearing, bearings, control gears, etc. The motor is a vertical four-cylinder 20-25 horse-power combustion engine of the constructor's own design. The running wheels are driven through the gearing, chain-wheel and chains, levers serving to actuate the forward and backward steering, and to regulate the carbureter and speed gear, while pedals are used to throw the motor out of gear. All levers and pedals are operated by the driver, from his stand on the locomotor platform, or from the ground beside the vehicle. The locomotor is fitted with a capstan, driven direct from the gearing, and which serves mainly for the actuating of turntables

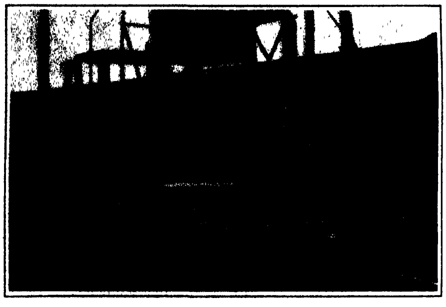
The uses of the locomotor are many. Being always ready to work at a moment's notice, and able, without any special manipulation, to travel in a forward or backward direction, it will convert any railway car into a motor coach, traveling along with it over turntables, operating these by the aid of its own capstan, hauling or pushing several cars at a time, loaded or empty, over any normal curves or gradients, and braking on a downhill course.

The locomotor is readily operated by one man and does not depend for the consumption of materials on the skill of the driver. There is no increase in consumption due to the weight of the engine itself, or the coal, water, steam, or accumulators carried. During intervals in operation there is no consumption of materials.

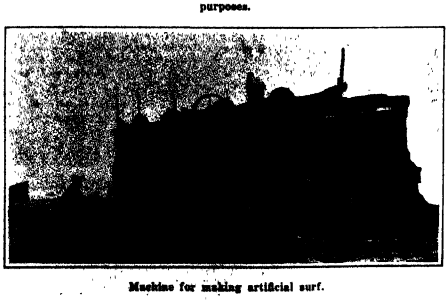
It is intended to fit the locomotor with transversal wheels, allowing of its leaving the track wherever desired, and travel from one track to another, thus avoiding any dead-end sidings or empty tracks, and insuring a considerable saving of time.

Electrical show at the Ohio State University.

Radio-equipped motor lifeboat for the "Aquitania."



Motor switching engine, utilizing the weight of a freight car for traction purposes.



Machine for making artificial surf.

Protection from Trichinosis has recently been investigated by the Bureau of Chemistry, with a view to establishing a basis for meat inspection requirements in regard to cooking pork products Experiments show that the trichinæ larvæ die after a brief exposure to a temperature between 53 deg and 55 deg Cent (127 40 to 131 deg Fahr) These temperatures are so low that one might expect very imperfect cooking to secure the desired result, It has been found, however, that the temperature in the interior of meat rises very slowly during the cooking process, and it is of course essential that the whole of the meat should be heated to a temperature high enough to destroy the parasites Tests for insuring a proper temperature have been devised, and will soon be put in operation in meat-packing establishments

Motor Lifeboats of the "Aquitania"

WHEN the passengers and crew of a vessel are forced to take to the lifeboats, if help does not arrive soon, the boats are apt to be so widely scattered that it is difficult for rescue ships to locate them A frightful illustration has only just been furnished us by a lifeboat that was picked up the other day with a few survivors two weeks after the other boats from the same wreck had been rescued No matter how good the lifeboat, it may fail in an emergency, because it possesses no means of propelling itself to safety and no means of communication with rescuers out of sight and hearing With this in mind, the owners of the "Aquitania" are furnishing that vessel with two large motor lifeboats fitted with wireless telegraph apparatus, these, of course, being additional to the regular lifeboat equipment. The motor boats are 30 feet long by 9 feet 6 inches wide They will be used to tow the ordinary lifeboats. The wireless apparatus has a range of 100 to 150 miles, which will enable them to keep in constant communication with steamers The boats are fitted with 4-cylinder, 30 horse-power motors, starting on gasoline and running on kerosene. The motor is well protected from storms by a closed compartment There is ample space for storage of blankets, medical stores, and other necessaries.

A Memorial to Jack Phillips, the chief wireless telegrapher on the "Titanic," is to be erected at his native town, Godalming, England It will take the form of a rectangular cloister of some 120 feet square, and will stand on glebe land near the parish church. The cloister style is a new form of memorial architecture in England, where it has been warmly approved by architects and art-lovers generally

Ocean Waves for Inland Resorts

THE odd-looking piece of machinery shown herewith is a wave-making machine It will make, to your liking, any one of a half dozen or more different kinds of waves Ocean waves, long rolling billows, short choppy waves, and, among others, the white-cap variety. It is possible to have a real Atlantic City surf just by switching on an electric motor, which sets the four plungers in motion These plungers work up and down in the water, and the different ways the plungers are worked make the different kinds of waves For instance, if long rolling billows are desired, the plungers are worked in unison If a short choppy sea is wanted, the plungers are worked independently of each other; when white-caps are wanted, two plungers are worked up and two down; this combination causes the waves to break into white-caps The different combinations of the plungers result in the different kinds of waves This unique mechanical device will be used at Summer resorts this season, on lakes that never saw a wavelet larger than a ripple.

How the Roots of Seedlings Write

Interesting Experiments for the Summer Season

By S. Leonard Bastin

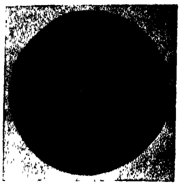
THE mystery of plant movement has always presented a problem of peculiar complexity to the botanist While the text-books discourse authoritatively upon the response of the protoplasmic matter in vegetable tissue to stimuli, the conscientious student is bound to confess that, after all, we know very little about the matter. The most that can be said is that certain parts of the plant may be expected to do certain things, because they have been endowed with a tendency in that direction Still, a very interesting line of study may be followed in connection with the movements of plants, and one which cannot fail to lead to instructive conclusions

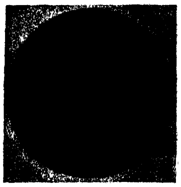
It was believed by Darwin that all growing shoots were constantly on the move, to a greater or less degree This habit is seen to the most pronounced degree in the species with twining stems and in some of the Acacias where the leaves maintain a continuous rotary movement The name given by the great scientist to this phenomenon was circumnutation and it was to this feature that Darwin thought he could trace all kinds of plant movement -a theory which is not however generally accepted at the present time Perhaps even more interesting was the fact that it was discovered that a very similar movement is to be noticed in the roots of young seedlings In this direction it is possible to carry out a large number of most fascinating experiments indicating the curious and beautiful courses which the radicles of growing seeds will trace in the early stages of their history

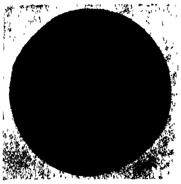
Probably one of the simplest devices by means of which the root movements of seedlings may be closely watched, is an ordinary photo printing frame These are, of course, very inexpensive, and answer all the purposes required Pieces of glass to fit the frames should be obtained, and for this purpose, of course, damaged negatives with the film cleaned away are exactly right It is also needful to obtain some pieces of very course canvas or fine netting, with a mesh through which the rootlets of the seedlings can easily force their way This material should be cut into pieces of such a size that they cover the frame, at the same time allowing for strips on either side to turn down A few tacks will complete the necessary things required for making the appliance for testing the root movements of seedlings The loose backs of the frames are now entirely dispensed with, and, as well, the clasps which hold down the hinged portion should be removed The next step is to place the frame face downward on a table and stretch the canvas across the back tightly, and holding it thus, fasten it down to the sides of the woodwork, as shown in the illustration It is important that the material should be pulled across quite tightly, as any sagging of the cloth is very undesirable

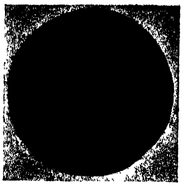
When the frames are completed, it is as well to start smoking the sheets of glass, in order that a suitable surface may be presented on which the seedlings may trace their movements. This may be accomplished in a variety of ways, but the best and simplest method is by using an ordinary candle. First of all make sure that the glass is quite clean and dry, and then taking it between the finger and thumb, hold it over the flame in a slanting fashion In order to get the greatest amount of smoke, the surface of the glass should just touch the top of the flame The glass should not be held for more than a second in any one position, as the heat will be likely to crack it, but if the sheet is kept moving about there will be no danger of breakage. Very soon the glass will become well clouded, but the process will not be complete until the surface is thickly coated with the smoke deposit, so that the slightest scratch will leave a sharp, clear mark. As each piece of glass is ready, this should be carefully stored away in a place of safety where there is no fear of damage being done, and also in a position sheltered from dust.

Almost any kinds of moderate-sized seeds are suitable for testing on the frames which have been prepared. Of course, very large kinds develop such big roots that these are unable to pass through the openings in the canvas, but putting these aside, there is an infinite variety in the subjects which may be tried. A peculiarity should here be noted in connection with the seeds of most leguminous species. Some small sorts of beans and peas have been tried, but it has been found quite impossible to induce them to trace their life history on the smoked surface. In most cases, before the tip of the radicle has reached the black surface, it has suddenly ceased growth and absolutely refused to push on downward to the impenetrable glass. This seems to indicate a perception which almost amounts to intelligence on the part of the radicle, giving yet further support to the theory that the tips of growing roots are as sensitive to their surroundings as are many of the organs of the lower animals. In order to make the experiments more interesting, an endeavor should be made to select as wide a variety of seeds as possible, so as to secure the greatest diversity in the records.

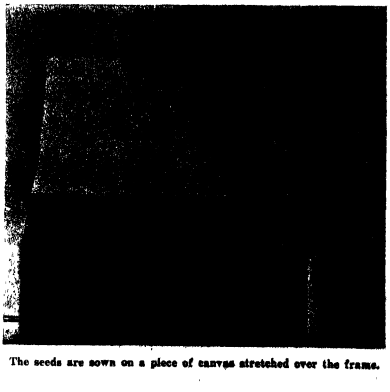

Seedlings of Centaurea cyanus.


Tracing by mustard roots.


Cress root tracings. These are among the best obtainable.


Produced by seedlings of wallflower (cheiranthus).

The framework is made out of a photograph printing frame.


The seeds are sown on a piece of canvas stretched over the frame.

The best method of sowing the seed on the surface of the canvas is to sprinkle it over with a spoon. The thickness or otherwise of the sowing should be arranged according to the nature of the pattern required. If the seeds are sown very thinly, each one being quite isolated from its fellow, we shall obtain a record most interesting from a scientific point of view, in that the actual movements of the individual radicle are placed on record. On the other hand, designs of great complexity are secured by sowing the seeds very thickly on the surface of the canvas. As soon as the sowing is accomplished, a thorough drenching of water should be given to the seeds, and care taken to see that the canvas is quite wet. All seeds, of course, germinate more rapidly in the dark, and in this case it is a wise plan to cover them with a piece of thick cloth or wadding which has been previously saturated with water. This will not only keep away the light, but will also serve the purpose of conserving the moisture. Of course, on no account must the seeds be allowed to become dry, and in order to make this quite impossible, it is well to stand each frame in a dish containing about half an inch of water. By capillary attraction, the fluid is drawn up all over the canvas, and one can well go away and leave the seedlings for a day or so, provided an occasional glance is given to see that the water is maintained at a proper level. There is a wide difference in the time which seeds take to germinate. Some kinds, such as mustard, cress, and nearly all the cruciferous plants, start active growth in a few days, while other sorts will lie dormant for quite a long period. Of course, another feature which goes a long way to control the rate of growth of any seeds, is the temperature. During warm weather, or if the seeds are kept in a heated apartment in Winter, the development will be much more rapid than when the conditions surrounding the seeds are chilly.

As soon as the germination is once started a close watch should be kept on the underside of the canvas for the appearance of the rootlets. At the first sign of the radicles, measures must be taken to place the pieces of smoked glass underneath, as in many cases the movements are most pronounced of all during the first stages of growth. It will probably be desirable to make some arrangements whereby the smoked surface can be brought nearer to the roots, and some means of supporting it underneath with strips of wood is easily adopted. It is necessary to make certain that the smoked glass is quite unscratched, and also in placing it in position that it does not get marked in any way. To insure this, the glass should not be placed nearer than an eighth of an inch to the roots which are growing downward so rapidly. The following day it will be observed that the roots have touched the surface and are already scribbling out a course. If the framework is held over one's head the lines of clear glass stand out prominently against the dead black, and the fascination of watching the roots writing out their life history will amply repay for any trouble which may have been expended on the preparations. Some of the prettiest formations are those in which the radicles are abundantly supplied with roots' hairs, a good example of which is seen in the case of the cress pattern.

Of course the roots may be permitted to write for a longer or shorter period, and it is a matter which varies with each kind as to how long the process should be allowed to proceed. Eventually, if the tracings are permitted to go on indefinitely, the radicles become so elongated that other portions besides the tip commence to touch the smoked surface, and in this way the record is spoiled. In removing the glass great care is required, and at this stage it will be an advantage if the sheet has been supported by strips of wood, as mentioned earlier. If this is the case, by sliding the pieces of wood out, the glass drops away without the least fear of the roots being dragged across the smoky surface. The sheets of smoked glass are so easily damaged that most people will probably be glad to preserve the record of the seedlings' roots in a more permanent form. The illustrations accompanying the present article were prepared in order to give the true effect of their appearance, but a much simpler method is that of printing directly from the glass, which has been used during the experiments. The plates may be used as negatives, the smoked side being turned outward in the frame, and the sensitive printing-out paper being placed next to the plain surface of the glass. Of course the result will be that the tracings of the roots will be in black, but this does not in any way affect the value and interest of the records.

While it is impossible to go very deeply into this interesting behavior on the part of the roots of seedlings within the limits of the present article, there is little doubt that it must play a very useful part in the life of the plant. One of the greatest dangers to the extending root is that of meeting some obstacle in its course which it is unable to penetrate. Now if all radicles were to go downward in a straight line, it is quite clear that the risk of coming to a dead stop would be considerable. On the other hand, the constant moving about from one side to another results in a continual change of position, so that if a stone or some such obstacle should stand in the way of the course, the tip of the root is speedily carried to an altered position. Even after the most careful observation of the root habits of seedlings, it is impossible to say how far these movements are habitual and how far they are controlled by actual environment. Indeed, in many cases it is difficult to avoid the conclusion that the underground organs of plants are gifted with special senses of which we have little or no understanding.

New Work in Spectrum Analysis

By John W. N. Sullivan

THE method of spectrum analysis is based upon the well-known discovery of Sir Isaac Newton, that ordinary white light, on being passed through a prism, is split up into light of different colors. If, after the light has passed through the prism, it be projected upon a screen, we find a series of colors ranging from red at one end to violet at the other. Such a series, obtained in this way, is called a spectrum. Instead of a prism, it is more satisfactory, for many reasons, to use what is known as a diffraction grating, which consists of a piece of metal or glass ruled with fine lines very close together, there being usually 10,000 to 20,000 of these lines per inch. A diffraction grating splits up composite light into its constituent colors, and does so in a uniform manner; whereas different prisms decompose light differently, a fact which renders prisms less suitable than diffraction gratings for scientific work.

The spectra produced by different sources of light differ enormously from one another, a fact which renders spectrum analysis possible.

Before considering some of the recent achievements in the domain of spectrum analysis, it will be convenient to adopt a broad classification which will include all spectra.

The spectra of light emitted from various sources and passing direct to the analysing apparatus are called emission spectra and may be divided into three classes:

Continuous Spectra, where we have merely a sequence of colors ranging from red to violet.

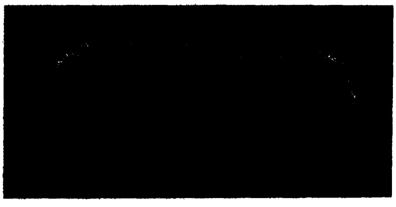
Line Spectra, where colored lines are found in their appropriate portions of the spectrum—for instance, a vivid green in the green region of the spectrum.

Band Spectra, where bands, sometimes of considerable width, take the place of lines in the spectrum.

In many cases bands may be split up into a number of lines packed very closely together by employing higher resolving power, but it is not certain that all bands may be split up in this way. The bands are usually more brilliantly illuminated at the edge nearest the violet end of the spectrum, although this is by no means an invariable rule. If now, instead of allowing the light to pass direct to the analyzing apparatus, we pass it through a gas or vapor at a lower temperature than the source of light, we get a different type of spectra, called absorption spectra. These spectra are characterised by having dark rays or bands on a bright background. The dark lines in the absorption spectrum correspond to bright lines emitted by the absorbing medium when in a state of incandescence.

If the light of the sun be examined by sufficiently high resolving power, it is found that its spectrum contains multitudes of fine dark lines, indicating the presence of absorbing gases in the sun's atmosphere. The exact positions of these lines in the spectrum are very carefully noted, and experiments are made to determine which gases have bright lines in corresponding parts of their emission spectra. In this way it is possible to identify the gases forming the atmosphere of the sun.

Corresponding to each line in the spectrum is a definite wave-length. If now the observer and the source of light are approaching one another, the wave-lengths appear shortened and the spectrum lines are shifted toward the violet end of the spectrum, where the wave-lengths are shortest. If, on the other hand, the observer and the source of light are receding from one another, the wave-lengths appear lengthened, and the spectrum lines shift toward the red end of the spectrum. From measurements of the amount of shift, the relative velocity of light source and observer may be calculated. It is in this way that the radial velocities of many stars have been measured.



The growing seeds in position, with the root tracing a course on the smoked glass.

Mammellicæ centricirrhha.

It is well known in our day that the visible spectrum is not the entire spectrum. Extending past the limits of visibility at the violet end of the spectrum, we come to the ultra-violet rays, whose presence may be detected by their action on a photographic plate. At the other end of the spectrum, extending below the red rays, we reach the region of the infra-red, which passes gradually into the region of the heat rays. The presence of the infra-red rays may be detected by their heat effects. Taking longer and longer rays, we reach, finally, the long electromagnetic waves, and in the other direction, far beyond the violet, it is now considered very probable that we reach those excessively short rays known as X-rays.

As an indication of the magnitudes involved, we may mention that the solar spectrum has been mapped out from wave-lengths 53,000 Angstrom units in the infra-red to 2,976 Angstrom units in the ultra-violet. An Angstrom unit is one ten-millionth part of a millimeter.

The wave-lengths of visible light lie between 4 by 10^{-5} centimeters and 7 by 10^{-5} centimeters. In the ultra-violet region waves as short as 1 by 10^{-5} centimeters have been discovered by Schumann, but in a paper published in 1912 by Friedrich, Knipping, and Lane phenomena are described which can only be due to waves of a length of about one hundred millionth of a millimeter, a length which is small compared to the radius of an atom!

A remarkable set of phenomena are comprised under the name *fluorescence*. It often happens that when light falls upon a substance, the substance emits light of a different color to the exciting light. This phenomenon is known as fluorescence and has been the subject of much recent work. Fluorescence is most markedly produced by the very refrangible rays, blue, violet, and ultra-violet.

In this connection Stokes enunciated the following law: The radiations emitted by a fluorescent substance possess greater wave-lengths and are less refrangible than those of the exciting light. It was at first believed that this law held good universally, but it was shown by Nichols and Merritt in 1904, in their researches on the spectra of fluorescent light, that in many cases this is not obeyed.

The fluorescence of bodies in the gaseous state was first observed by Lommel in his studies on iodine vapor, and later a whole series of fluorescent vapors have been discovered.

Some very remarkable work on the fluorescent spectra of sodium and iodine has been done by R. W. Wood. The spectra obtained by exciting sodium vapor or iodine vapor by light of a small range of wave-lengths (monochromatic light) he calls resonance spectra. It would appear that light of a certain wave-length falling on the systems of electrons which constitute the atoms of the vapor set up vibrations of the same, or approximately the same frequency, producing corresponding lines in the spectrum, that we have, in fact, a case of resonance. There would appear to be a strong connection between the bright resonance lines of these vapors and the dark lines of their absorption spectra. In all Prof. Wood's earlier work, he was of the opinion that each bright resonance line was in coincidence with some one of the numerous dark absorption lines, but in his last paper (*Phil. Mag.*, November, 1913) he finds that this is not the case. There can be no doubt that further study of these spectra will throw much light upon the intimate structure of the atom.

Spectrum analysis is thus seen to have a wide range. It is our only means of obtaining information as to the physical constitution of the heavenly bodies, and at the other end of the scale, it teaches us a great deal about the constitution of the smallest bodies in the universe.

The Disappearance of Gustav Hamel

EARLY in the morning of Saturday, May 23d, the well-known English aviator, Gustav Hamel, left Villacoublay, France, for Hendon, England. He was last identified at 12:15 P. M., when he left Hardelot, near Boulogne, on his way to Hendon, but a monoplane supposed to have been his was seen high in the air above Boulogne at 12:30 P. M. Wireless messages were sent to all ships in the Channel to watch for the aviator, but none of them has made a report of having seen the machine. Hamel recently announced that he would attempt to fly across the Atlantic for the Harmsworth prize. He was the first to repeat the upside down performances of Pegoud. His fate recalls that of Cecil S. Grace, who crossed the English Channel from England to France in December, 1910, and who disappeared on a return flight on December 22d.

A New Record for Dirigibles

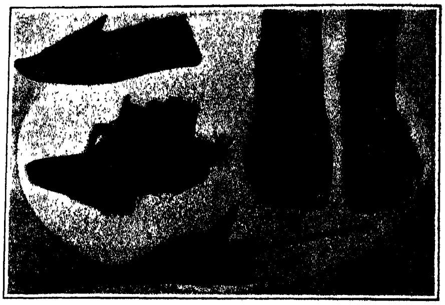
THE new navy Zeppelin "L 3" recently stayed aloft for thirty-four hours, during a voyage from Friedrichshafen to Potsdam. An average speed of nearly 60 miles an hour is said to have been attained. While over Heligoland the "L 3" was in communication by wireless with dirigible "LZ 24," which was over Friedrichshafen.

Powerful Wireless Outfit for the Army.—According to the *Army and Navy Journal*, should an advance be made on Mexico, great reliance will be placed upon a strong force of cavalry assisted by aviators and an unusually powerful wireless outfit. A test was made by the Signal Corps at Washington of a wireless outfit mounted on a heavy automobile truck, which has an estimated range of 200 miles. If this range is realized, the Army will be in touch with the base at Vera Cruz until it reaches the gates of Mexico City.

Ancient Footwear Found in London

THE ancient shoes and sandals, pictured in the accompanying engraving, are not replicas, but the actual footwear of men who once trod the streets of London. They were dug up within the city limits and are on exhibition at the city museum. The two sandals shown date back to the days of the Romans. They were found in the peaty deposit of the Moorgate Street district They have been set up on plaster feet. On the left are two Saxon shoes. The one at the top resembles the Scottish and Irish brogue used at the present day in the Shetland Isles. It was discovered in London Wall. The shoe directly below it, with the iron stirrup, was found in the Ditch, Newgate. The shoe with long-pointed toe, at the bottom of the engraving, belongs to the early fifteenth century. The iron stirrup was found in Westminster, while the spur was dug up in Thames Street

It was during the reign of Richard III that this odd shoe, or "poulaine," was in fashion To keep the long toes of these shoes in shape, they were stuffed with moss



Courtesy of the *Sphere*

Curious ancient footwear dug up in London.

Measuring Moisture at a Distance

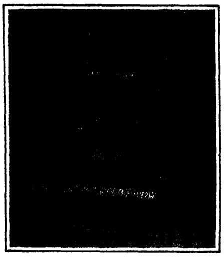
IN granaries, breweries, malt houses, spinning mills, gunpowder and explosive factories, grain houses, etc., great importance attaches to the amount of water vapor present in the air, and it is necessary that the amount of moisture present in the air should be capable of determination at any time with the minimum of trouble

One of the difficulties in this connection is the fact that many of the positions in which the atmospheric conditions have to be determined are not suitable for accurate observation, and hence the Constanz Schmitz system of hygrometers suitable for measurement at a distance. The Schmitz hygrometer is based on the principle of the well-known aspiration hygrometers Thermometers of a special type are used, consisting of a resistance coil of pure platinum wire, wound in a spiral form, on a central quartz tube, which is then inserted into a closely fitting outer protecting tube of the same material The whole arrangement is fused together, so that the platinum spiral is hermetically sealed, while any risk of the short-circuiting of adjacent turns is completely eliminated. The resistance of the spiral is accurately adjusted to a definite value. Two of these quartz glass resistance thermometers are mounted in an oblong case which is fixed in the room whose hygrometric condition is to be controlled; the accompanying drawing shows the arrangement One of the thermometers *A* is covered with a porous tube which is partly immersed in distilled water contained in a tray *C*, which serves to keep the thermometer wet. The second resistance thermometer *B*, separated from the thermometer *A* by a diaphragm *D*, is the so-called dry-bulb thermometer The air whose hygrometric condition is to be determined, passes through the oblong case and causes evaporation to take place on the surface of the wet-bulb thermometer *A*, with the result that heat is extracted from it in this way. A difference in temperature between the wet-bulb thermometer *A* and the dry-bulb thermometer *B* is set up. If the air were saturated with moisture, no evaporation would occur, and in this case the temperature of the two thermometers would be identical On the other hand, if the air were very dry, rapid evaporation would take place on the surface of the wet-bulb thermometer *A* and its temperature would be reduced, causing a considerable difference in temperature between the two thermometers The relation between this difference in temperature and the humidity at various temperatures has been determined scientifically A ventilator fan provides the proper velocity of air past the thermometers. The fan motor is switched on and off simultaneously with the thermometers. A central temperature indicator is mounted on a switch-board, to the back of which are fixed the necessary resistance coils and connections. Below the indicator are the push-buttons, by means of which any one of the distance hygrometers may be connected to the indicator. There is also a variable resistance to eliminate any error due to slight variations in the voltage of the battery by adjusting the resistance, while a test key is depressed until the indicator pointer shows exactly full-scale deflection. The push-buttons are interlocked, so that it is impossible to connect more than one thermometer with the indicator at the same time. When a button is pressed down, it remains down until a second button is depressed, when it automatically returns to "off" position.

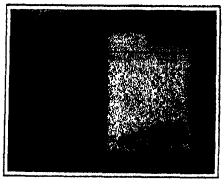
One button is provided as a releasing key, for use when it is desired to disconnect a point without connecting another in its place.

To take a reading, the push-buttons for the wet and dry-bulb thermometers are depressed, one after the other, and the temperatures are read off on the scale. By using a suitable conversion table, the readings can then be translated into measures of relative humidity. The instruments are of the Siemens type and have been produced in England.

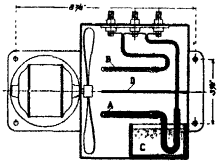
Bottom lowered to provide access to the water tray.



Casing removed to show the thermometers.



Hygrometer in normal closed position.



Sectional view of the hygrometer.

Aeroplanes and Gyrostat Control

A DEMONSTRATION of gyrostatic action was given recently before the Physical Society meeting in the Imperial College of Science, by Dr. G. Gray, of the Department of Natural Philosophy at the University of Glasgow. Dr. Gray showed three distinct methods of producing stability in a gyroscope mounted on such a moving body as a torpedo or an aeroplane. In the first method he mounted a gyroscope with two instabilities on a body supposed to be stable of itself. The construction and method of mounting was such that the stability of the gyroscope was derived directly or indirectly from the propeller forces. When the body was at rest the stability of the gyrostatic system was not complete; but, when the body was moving, even very slowly, the gyrostat was completely stable, and was then available for steering the body.

A second form of gyrostatic control was shown applied to the production of gyrostatic [illegible] [illegible]. When the machine tended to tilt to the left, as seen by an observer viewing it from behind and above, the front wheel was turned to the right of the observer (instead of to the left as in the ordinary machine) and the bicycle was righted by gyrostatic action. This device was said to be available for torpedoes and small aeroplanes.

A method of connecting up the gyrostat to the steering mechanism was described, a very small couple applied by the gyrostat resulting in the application of a very large couple to a vertical rudder at the stern of the torpedo, the couple being applied by means of a geared motor. A third kind of motor-car was shown, consisting of a front part and an *after* part, the two being connected by means of a vertical hinge The first part carried a gyrostat and the after part the propelling mechanism. The back portion applied a simple pushing force to the front portion. This system, which would appear on the face of it absurd to the ordinary observer, was completely stable when the gyrostat was spinning and the model was moving forward. The gyrostat detected any tendency to tilt, and obtained from the propeller the forces and momentum requisite to produce stability.

The lecturer also illustrated the application of gyrostatic action to the manipulation of the aeroplane. He proposed to fit an aeroplane with a gyrostatic nose, which would be available forcibly to maneuver the aeroplane. He explained that it would be fairly easy to construct such an aeroplane on a small scale. Elaborate experiments, however, would be necessary, and these were not possible for a private individual. Brought to perfection, such an aeroplane would be invaluable for reconnoitering purposes. It would possess stability in the air, which present-day aeroplanes certainly do not have. It could, as it were, turn on a pivot, and could be raised and lowered in the air by means of forces derived directly from the propellers.

Safer Night Driving for Chauffeurs

SO perfect is the headlight of to-day, that it affords remarkable safety in illuminating the roadway so far ahead as to give more than sufficient time to bring the car to a stop in front of any obstacle. But this very strength of automobile headlights is the thing that has created the second problem. Powerful light ahead, while diminishing the risk of accident for one driver, only increases the danger for a driver coming in an opposite direction. Every motorist knows how he is practically blinded when the glaring headlights of an approaching automobile strike him like a blow in the face. A sensible solution of the problem is the two-color goggle. This solution does *not necessitate* a weakening of the headlights, or prohibition of their use, or in any sense deprive the driver of the safety afforded by these strong headlights. This goggle has all the features of the ordinary goggle for day driving, with the additional feature of an extra segment in the top of each lens. The main and lower section of the glass is of light amber, and the vision is through this portion for ordinary driving. Above this, in the top of the lens, however, is a smaller segment of darker amber, and when the driver is confronted by dazzling headlights at night, he simply tips his head, to bring vision through this dark segment, which so reduces the glare that the approaching machine and roadway can be seen with perfect clearness. While this extra dark segment was added particularly for strong headlights at night, it has also proven to be a great advantage when driving along seashore, sand, or ordinary roads in the glare of bright sunshine. This dark segment then acts as a shade, or "cap visor," affording protection from the very strong daylight.

French Mistletoe in England

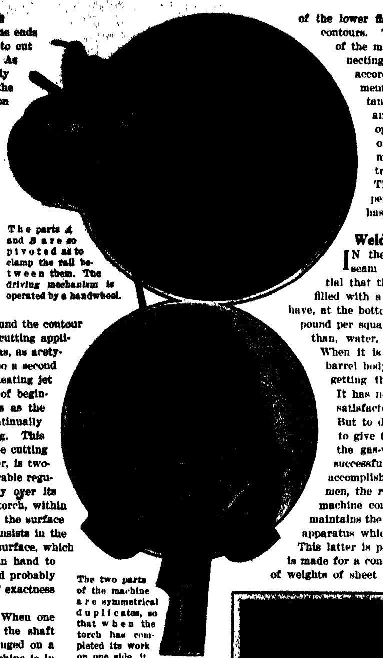
ALTHOUGH mistletoe grows in England, the bulk of that used for Christmas decorations in that country comes from the apple orchards of Normandy. In 1912 the London and South-Western Railway alone handled 1,500,000 bunches, weighing 650 tons and worth $300,000.

Cutting Street Car Rails With Gas

On account of the excessive wear-and-tear on the ends of street car rails, it is frequently advisable to cut away short sections and make replacements. As these rails, especially within city limits, are largely buried beneath the surface, it is desirable to do the cutting with the rails in place. A recent invention permits this service to be performed in an economic and excellent manner. The invention is a portable piece of apparatus, which may be put in place by one man. There are two parts *A* and *B* pivoted above, which may be made to clasp the rail between them, somewhat after the manner of a pair of tongs. These parts have, each of them, a driving mechanism adapted to turn the torch *C* through a large arc in such way that the nozzle will follow the contour of the rail. The driving mechanism is operated by a handwheel above. The two parts of the machine are symmetrical duplicates, so that when the torch has completed its work on one side, it may be detached and put in position on the other part, where it may be driven around the contour of the other side of the rail. The torch is a gas-cutting appliance. That is, it delivers a heating jet of a fuel gas, as acetylene or hydrogen, mixed into oxygen. There is also a second jet of oxygen, which is turned on as soon as the heating jet has sufficiently heated up the work at the point of beginning. The cutting then commences and continues as the compound torch moves around. The heating continually goes on just a little ahead of the actual cutting. This work could be done by hand operation of a suitable cutting torch. The advantage of using a machine, however, is twofold. In the first place, there is gained a very desirable regularity of movement; the torch is carried steadily over its path. Besides, the mechanical method holds the torch, within very close limits, to a predetermined distance from the surface of the work. The second part of the advantage consists in the control of the torch in positions at and below the surface, which would be difficult, if not dangerous, for the human hand to take. Hand operation of a rail-cutting torch would probably result in great waste of gas because of the want of exactness in handling.

The mode of operation is, briefly, as follows: When one of the handwheels is turned, a bevel pinion on the shaft carrying the wheel drives another bevel gear arranged on a second shaft. These two shafts are, when the machine is in place, both in one horizontal plane. One is perpendicular, however, to the other. The second shaft carries a worm which engages a wormwheel arranged on a shaft oblique to the horizontal plane. This third shaft runs down into one of the clover-leaf cases seen in the photographs. By a system of bevel and spur gearing, this third shaft transmits its drive alternately to a shaft perpendicular to the surface of the paper, on which shaft the torch is secured. The entire drive from the handwheel to the shaft for the torch provides for just two principal things: (1) reduction in rotary speed, and (2) rotary operation of the shaft holding the torch.

The torch is secured to its shaft by means of a slide lying in a vertical plane transverse to the web of the rail. At one end of this slide is the torch; at the other, a roller or traveler in contact with a cam track. While the turning movement is being accomplished, the roller rolls against the cam track, the result being that the nozzle of the torch follows accurately the contour of the rail, beginning, say, beneath the outer edge of the upper flange, then working in toward the web, then turning to follow the fillet between flange and web, then working down the web to the lower fillet, around it and out to the outer edge of the lower flange. Different cam tracks provide for different contours. The oblique shaft belonging to the opposite half of the machine is driven by a bevel-gear arrangement connecting the two oblique shafts. The two oblique shafts accordingly turn in opposite directions. The arrangements are such that if two torches be secured simultaneously in place, both will move downward together and upward together. Such a machine may be operated by a comparatively unskilled workman, once the proper adjustments have been made. It may be moved from point to point on a small hand truck, together with the tubes containing the gases. The amount of earth that has to be removed to permit of operation is small in amount. Only a little has to be taken out beneath the rail.

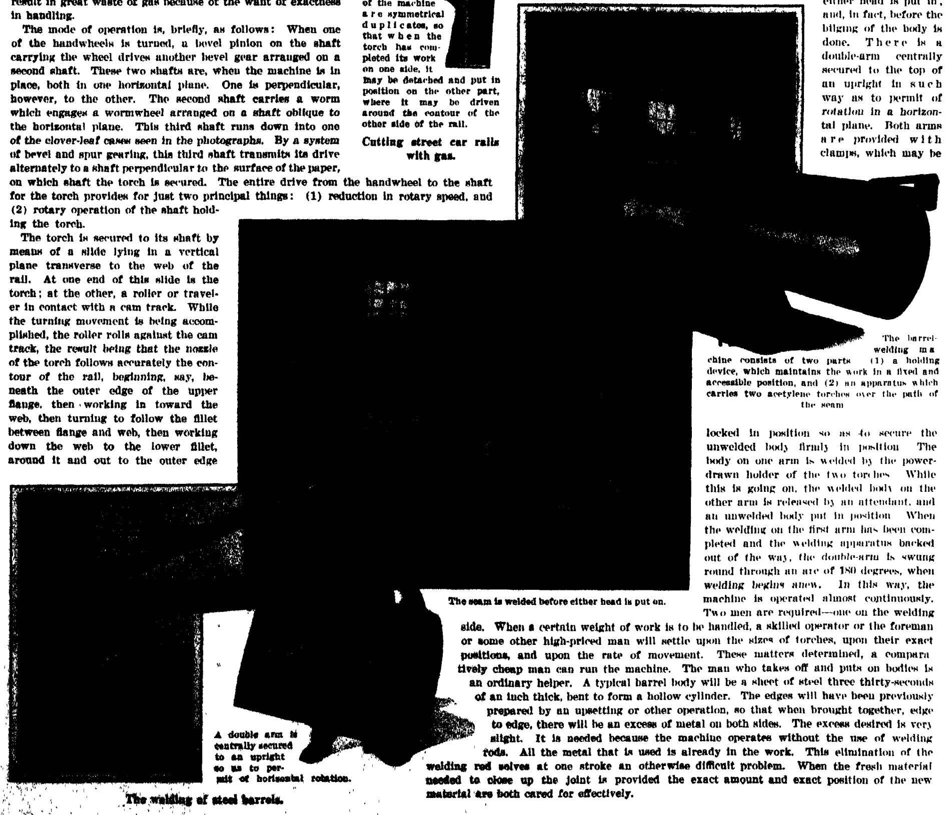

The parts *A* and *B* are so pivoted as to clamp the rail between them. The driving mechanism is operated by a handwheel.

The two parts of the machine are symmetrical duplicates, so that when the torch has completed its work on one side, it may be detached and put in position on the other part, where it may be driven around the contour of the other side of the rail.

Cutting street car rails with gas.

Welding Steel Barrels With Oxy-acetylene Torch

In the manufacture of steel barrels, the longitudinal seam constitutes a principal problem It is very essential that this seam be one not subject to leakage A barrel filled with a liquid of the same specific gravity as water will have, at the bottom of the seam, an internal pressure of about one pound per square inch. If the liquid is as fluid as, or more fluid than, water, there will be a considerable tendency to leak. When it is borne in mind that it is desirable to bilge the barrel body after the seam has been made, the difficulty of getting the best results will become still more apparent. It has now been found that a gas-welded seam will prove satisfactory, if sufficient care is exercised in making it. But to depend upon the skill of the welding operator and to give the time necessary for hand operation would make the gas-welding solution of the problem only moderately successful. Accordingly, a machine has been devised which accomplishes in half the time, with comparatively unskilled men, the results of highly skilled labor The barrel-welding machine consists of two parts: (1) a holding device which maintains the work in a fixed and accessible position; and (2) an apparatus which carries two torches over the path of the seam This latter is power drawn. By suitable arrangements, provision is made for a considerable range of speed, thus permitting a variety of weights of sheet metal to be handled. The seam is welded before either head is put in, and, in fact, before the bilging of the body is done. There is a double-arm centrally secured to the top of an upright in such way as to permit of rotation in a horizontal plane. Both arms are provided with clamps, which may be locked in position so as to secure the unwelded body firmly in position The body on one arm is welded by the power-drawn holder of the two torches While this is going on, the welded body on the other arm is released by an attendant, and an unwelded body put in position When the welding on the first arm has been completed and the welding apparatus backed out of the way, the double-arm is swung round through an arc of 180 degrees, when welding begins anew. In this way, the machine is operated almost continuously. Two men are required—one on the welding side. When a certain weight of work is to be handled, a skilled operator or the foreman or some other high-priced man will settle upon the sizes of torches, upon their exact positions, and upon the rate of movement. These matters determined, a comparatively cheap man can run the machine. The man who takes off and puts on bodies is an ordinary helper. A typical barrel body will be a sheet of steel three thirty-seconds of an inch thick, bent to form a hollow cylinder. The edges will have been previously prepared by an upsetting or other operation, so that when brought together, edge to edge, there will be an excess of metal on both sides. The excess desired is very slight. It is needed because the machine operates without the use of welding rods. All the metal that is used is already in the work. This elimination of the welding rod solves at one stroke an otherwise difficult problem. When the fresh material needed to close up the joint is provided the exact amount and exact position of the new material are both cared for effectively.


The barrel-welding machine consists of two parts (1) a holding device, which maintains the work in a fixed and accessible position, and (2) an apparatus which carries two acetylene torches over the path of the seam

The seam is welded before either head is put on.

A double arm is centrally secured to an upright so as to permit of horizontal rotation.

The welding of steel barrels.

RECENTLY PATENTED INVENTIONS

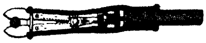
These columns are open to all patentees. The notices are inserted by special arrangement with the inventors Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

GARMENT HANGER.—A. BUCHWALD, care of Isidor Frank, 1673 Madison Ave, New York This hanger consists of a cardboard blank bent to form a head and chest with a hook projecting from the head The bent chest portion of the hanger holds the chest portion of the garment out in normal position, while the head of the hanger indicates the proportion and style of the garment, relatively to the bust of a normal person.

Electrical Devices.

CONNECTING CLIPS FOR ELECTRICAL CONDUCTORS J G ELKIN, care of Manhattan Motor Co, 68-72 E 131st St New York The clip here illustrated may be securely fastened to insulating conductor wire, enabling it to be quickly and conveniently attached to or detached from a binding post or the like It consists of a pair of spring pressed jaws pivotally connected and a clamp on the pivots of the jaws, adapted to engage the bare end of the wire conductor together with means for closing or opening this clamp


CONNECTING CLIPS FOR ELECTRICAL CONDUCTORS

TELEGRAPH RECEIVER—A PARODI, 38 Macdougall St, New York The invention relates to telegraph receivers producing a record adapted to actuate mechanism whereby messages may be received through the sensations of hearing and sight The primary object of the invention is the provision of a telegraph receiver adapted to record messages on a continuous tape, the construction being characterized by a new and improved means for feeding the tape

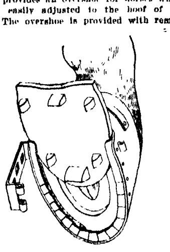
Of Interest to Farmers.

GATE OPENING MEANS—H SOMERS, Armstrong, British Columbia, Canada The invention relates to operating means for road gates, designed to be operated by a driver or equestrian, to open the gate and then to close the gate after having passed through The mechanism is such that it may be operated from either side to cause the gate to open away from the operator

PULVERIZER—J C MIRE, Dreyfus, La Mr Mire's invention consists of a pulverizer especially adapted for pulverizing the soil in the furrow It is designed to be attached to a turning plow to pulverize the soil as it is turned It comprises a bar having laterally extending arc shaped teeth, which gradually increase in size from one end of the bar toward the other

Of General Interest.

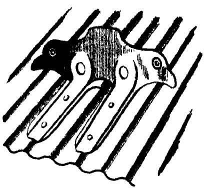
OVERSHOE FOR HORSES—MABEL BLACKMAN, 204 West 82nd St, New York The invention provides an overshoe for horses which may be easily adjusted to the hoof of the horse The overshoe is provided with removable soles formed with calks arranged to prevent slipping. The calks may be made of a material that will not injure pavements and yet will furnish a good footing under all conditions


OVERSHOE FOR HORSES

ANTI-FREEZING OUTLET VALVE FOR TANK—J W WHIPP, care of L D Ratcliff, Decatur, Texas. In cold weather much difficulty is experienced with the outlets of tanks and the like which are apt to become frozen This is obviated in the present invention by providing an air space about the valve stem so that no water comes into contact with the stem or rod at the level of the water in the tank.

VENTILATING SHOE OR SLIPPER TREE—W. A. NICKLESS, care A. Steinhardt & Bro, 860 Broadway, New York, N Y. In order to ventilate the shoe or slipper thoroughly and prevent undue shrinking of the leather this tree is made with a toe or a vamp form having longitudinal passages beginning at the back of the form and extending forwardly and vertical passages intersecting the longitudinal ones and extending from the bottom of the form to the arched top thereof.

SNOW GUARD FOR ROOFS.—A. DANNER, Hagerstown, Md. The snow guard consists of a plate metal piece rolled to the form shown in the illustration. It may readily be attached to a roof Preferably it is used alone, but if desired a bar or board may be secured to the upper side of the plate by means of screws inserted through the holes in the plate.


SNOW GUARD FOR ROOFS.

Heating and Lighting.

ATTACHMENT FOR GAS METERS.—J. G. HAYDEN, New Lexington, Ohio In order to remedy the offset caused by shrinkage or expansion of the diaphragms in meters which depend on the pull of a diaphragm to operate a planetary valve controlling the passage of gas through the meter, the present invention provides an adjustment of the valve operating mechanism to compensate for the variable amplitude of swing of the actuating diaphragm.

PROCESS FOR PRODUCING COMPRESSED AIR OR COMPRESSED GAS ESPECIALLY FOR OPERATING OF LAMPS—W. LIEDKE, 17 Grolemannstrasse, Berlin-Charlottenburg, Germany This process of compressing air or gas for feeding lamps consists in vaporizing quicksilver, ejecting the vaporized quicksilver into a body of air or gas to force the latter along with the vapor into a reservoir to compress the same therein, and conducting the compressed air or gas to the lamp.

Household Utilities.

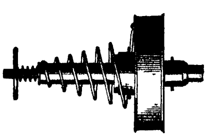
TRAY.—M. B. SOLOMON, care of American Tray Co., 233 Mercer St., New York, N. Y The purpose of the inventor is to provide a tray arranged to permit of conveniently assembling the tray, bottom, frame and railing and fastening the same together without resorting to soldering, at the same time forming an exceedingly strong tray which is also neat and ornamental

DRIP WATER SAFE—J. J. HICKEY, 2130 Lexington Avenue, New York, N. Y The invention relates to sanitary engineering and has particular reference to improvements in plumbing apparatus associated particularly with iceboxes, refrigerators or the like. It provides a very simple drip water reservoir or safe for refrigerators which may readily be applied to or removed from the main waste pipe without the use of tools

CREASING IRON—H W POGUE, 1745 North Church St, Decatur, Ill The invention relates to irons for creasing trousers, coats and other garments and provides the iron with opposed members between which the portion of the garment to be creased is received, the members being provided with guiding runners to assist the user in guiding the iron

Machines and Mechanical Devices.

TRANSMISSION DEVICE.—J. W. HOWSEY, Darlington, Wis The invention provides a transmission device with an interposed spring, affording a cushion between the driving pulley and the shaft actuated thereby It is particularly useful in driving cream separators or dynamos requiring very steady speed and may be employed with an internal combustion engine, to absorb the shock due to the periodic explosion

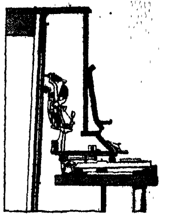

SHOCK-ABSORBING PULLEY.

SAW SHARPENER.—P. HILSINGER, Killawog, New York The inventor aims to improve the construction of saw sharpeners and increase their efficiency without unduly complicating the mechanism employed With the improved device the handling of the saw is greatly facilitated and the placing of the saw teeth for the purpose of operating upon them is rendered specially accurate.

FIBER SEPARATING MACHINE.—M. E. PARKS, Box 541, El Paso, Texas. The invention relates particularly to a machine in which the separating element travels faster than the feed crushing roll, but slower than the drawing roll, so that the butt end of the plant stock can be effectively acted upon by the separating element, there being coacting [illegible] devices which carry tools to remove the bark, pulp or other matters from the fiber.

Musical Instruments.

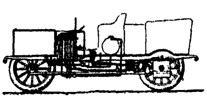
TRANSPOSING DEVICE.—J. VACCARO, deceased; PIETRO VACCARO, administrator, 79 Franklin St., Bristol, R. I. In order to permit of playing a piece on the piano a half tone, whole tone, or several tones higher or lower than the one to which the piano is ordinarily tuned, a shiftable connection is interposed between the keys and the abstract of the piano action. A locking device is provided for engaging the rear ends of the keys to hold them in lowermost position, and the operating means for this locking device forms a locking device for the shiftable connection.


TRANSPOSING MECHANISM FOR PIANOS.

Prime Movers and Their Accessories.

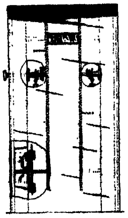
CARBURETER.—L. R. MILLER, JR., Dodge City, Kansas. Mr. Miller has for his object in this invention to provide an improved carbureter having a movable mixing tube, so shaped and moved that it acts as a throttle and is connected to the usual throttle operating mechanism and is operated in the same manner as the throttle is operated.

VEHICLE POWER PLANT.—E. F. HOWE, El Centro, California To provide a simple transmission between the motive power generator and the wheels of an automobile, Mr Howe has invented a vehicle power plant, generating and using compressed fluid, which does not require a large number of mechanical elements for its transmission. The plant comprises a rotary explosive engine, a fluid compressor and a reversible fluid motor for propelling the vehicle


POWER PLANT AND TRANSMISSION FOR AUTOMOBILES.

Railways and Their Accessories.

STREET INDICATOR FOR CARS.—F. H. WEBSTER, Marvell, Ark. The invention provides a street indicator in which the names of successive streets are printed upon a band which is moved by a step by step mechanism. When a car passes a street, the name of which is not to be displayed, such name will be practically skipped, although it may be carried upon the band An automatic reversing mechanism comes into play when the car reaches the end of its route and starts upon its return trip.


STREET INDICATOR FOR CARS.

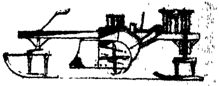
RAILWAY-SPIKE—L. WECHSLER and R. SCHERER, 19 West 118th St., N. Y. The shank of the spike is divided into a number of points adapted to be deflected outwardly and upwardly when forced into a railway tie. A spreading member is provided which is adapted to fit in a bored out socket in the tie so as to cause the points to be deflected with the least possible mutilation of the wood.

AUTOMATIC RAILWAY GATE.—H. GOSKLAR, 206 W. 151st St., New York, N. Y. Hydraulically operated gates for railroad crossings, adapted to be automatically closed before an approaching train and opened after the train has passed, [illegible] tion. The mechanism [illegible] inter-communicating cylinders [illegible] stern, the plunger of a larger cylinder [illegible] adapted to be engaged by a vehicle moving on the track, while the smaller cylinder is fitted with a plunger that operates the gate.

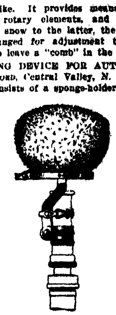
AUTOMATIC RAILWAY GATE.

Vehicles and Their Accessories.

SNOW PLOW—W. L. BRADIG, St. Francis, Maine. This invention provides co-acting means for taking up the snow and causing it to be raised and deflected to the side of the road. It removes snow from highways, logging roads, and the like. It provides means associated with the rotary elements, and adapted to gather the snow to the latter, the said means being arranged for adjustment to the road level, or to leave a "comb" in the road center.


IMPROVED SNOW PLOW.

WASHING DEVICE FOR AUTOMOBILES.—H T. FORD, Central Valley, N. Y. The invention consists of a sponge-holder which may readily be applied to the nozzle of a hose, for washing an automobile, so that the sponge will be directly in line with the stream of water issuing from the nozzle, and may, when desired, be thrown out of this stream, to permit the stream to be played directly upon the parts to be wished.


WASHING DEVICE FOR AUTOMOBILES.

Designs.

DESIGN FOR A VEHICLE FRAME.—J. WORKSMAN, 30 S Main St., Asbury Park, N. J. The design covers a frame of rectangular form coupling two bicycle forks. The frame is attached to the heads of the forks, while there is a spacing member secured to the forks at their lower end, and diagonal bracing members running from the head to the center of the spacing member.

DESIGNS FOR TUMBLERS, GOBLETS, JUGS, OR SIMILAR ARTICLES.—W. E. HUNTER, care of Economy Tumbler Co., Morgantown, W Va. Mr. Hunter has obtained three patents on ornamental designs for tumblers, goblets, jugs, and the like. The designs consist of ornamental bands adapted to be run around the body of the vessel. One of the designs provides for a band of leaves interrupted at intervals by a conventional figure and a spray of flowers. A second design consists of a conventional chain or rope effect, under which there is a wavelike band. The third design consists of a band made up of conventional flowers in the form of scrolls, with a band of leaves above and a draped effect below.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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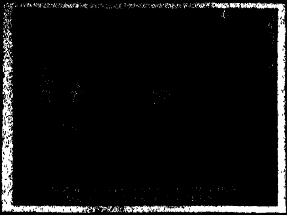

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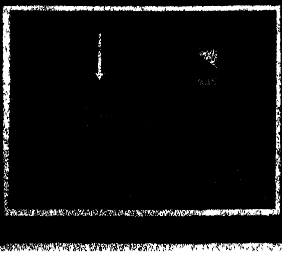

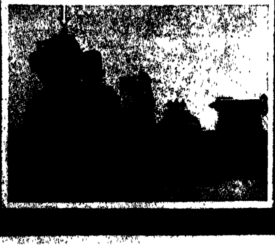

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WESTERN ELECTRIC COMPANY

Analytical Comparison of the Bird and Monoplane.

(Concluded from page 462.)

retained without employing the treacherous wire.

The control of the machine is very simple. The ascent is made by pushing downward and forward on the steering-wheel; the descent by pulling the wheel backward and upward. Steering from right to left is accomplished by turning the wheel from right to left, similarly to steering an automobile. Lateral balance is gained by operating a second wheel in conjunction with, or independent of, the steering-wheel.

The landing chassis is very simple, composed of two wheels and a skid. The wheels are mounted on V-shaped members and suspended on twin coil-springs, lying parallel with the body of the machine. After leaving the ground the wheels are folded upward and inward, disappearing through apertures in the body of the machine, which are closed by sliding doors. The wheels are folded by worm-gears operated by the feet of the aviator.

Three-bladed propellers are employed. The motor turns 1,000 revolutions per minute, while the propellers turn 750 revolutions per minute. Propellers are mounted on the entering edge of the main planes, five and one half feet from the sides of fuselage. This plan gives the tractile power at the points most needed.

The seat of the observation officer can be turned from side to side or raised or lowered, similar to a piano stool. This method of mounting the seat affords a wide scope of vision. The machine-gun of demountable form, which may be raised or lowered or turned from side to side, is mounted on the cowl, directly in front of the observation officer. Two port-holes are built in the bottom of the fuselage just below the pilot and observation officer. These openings afford a splendid view of the underlying country Bombs may be dropped, the machine-gun fired, and pictures taken through them. These port-holes can be closed with sliding steel doors when necessary, for protection from the enemy. The machine is fitted with regulation wireless outfit. The electricity is supplied by a generator and storage battery, which also supply the searchlights when flying at night. A small rain-vision wind-shield is fitted to the cowl just in front of the occupants, which gives good protection during high speed and stormy weather. Gas and oil tanks are mounted between the pilot and motor over the center of pressure, according to standard practice. Rubber rope or chain is used to transmit the power from the motor to the propellers. Generous sized air-cushions are used to upholster the seats and cock-pit of the fuselage. These will protect the aviator and passengers in case of a hard landing. All instruments that assist the aviator are placed directly inside the cowl in front of the pilot.

Weaving Real Persian Rugs

(Concluded from page 464)

a pile thread t is left dangling between the warp threads a, a^1 in front of the crossing a^2. The warp threads a, a^1 are now returned to normal position, as shown in Fig. 5, whereby the loose end of the pile thread t extends downwardly on the outside of the warp thread a, is looped over the warp thread a, passes between the warp thread a, a^1 and around the other warp thread a^1 to then extend upward on the outside of this warp thread a^1. The tuft yarn tube h is now again passed downward between the now parallel warp threads a, a^1, as shown in Fig. 6, to complete the Persian knot, and while the tuft yarn tube h is in this lowermost position, the pile thread is cut by a transversely moving knife k, after which the tuft yarn tube h rises to uppermost position. One, two, or more weft or binding threads l are now passed through the opened shed and the Persian knot and weft thread are beaten home by the lay.

The selection of the yarn tubes carrying the differently colored pile threads t is made by the overhead Jacquard mechanism, the perforate cards of which may

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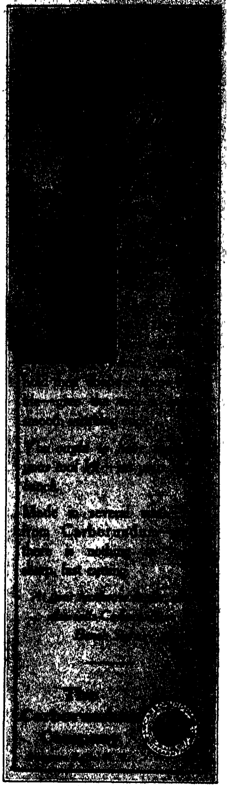

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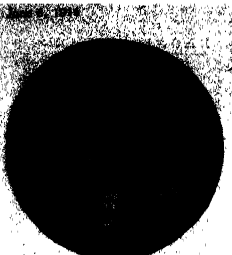

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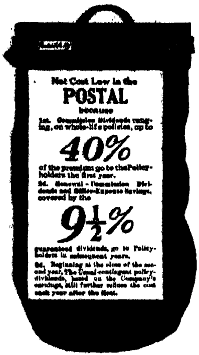

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RIFE ENGINE COMPANY

[illegible]

be regarded as equivalents of the *talim* sheets used by the Oriental weavers. The loom is wholly automatic, and at each operation, as above described, a whole row of pile knots is made, corresponding in color to a predetermined design.

What a very industrious Oriental weaver can weave in about a year this loom accomplishes in a single day, and consequently the product made by this loom can be sold considerably cheaper than the hand-made product, considering the quality of the material as being alike.

The power loom shown in our illustration weaves a rug 10½ feet wide and of any length, according to the design. It was built by the Crompton and Knowles Loom Works, whose faith in the invention was largely instrumental in achieving success.

The importance of this invention of Mr. Dalkranian was early recognized by the late Mr. Nazar Costikyan, founder of the well-known firm of Oriental rug importers, Costikyan Bros. & Co., of New York city, and through Mr. Costikyan's financial assistance and that of his son, Mr. Mihran N. Costikyan, the inventor was enabled to reduce his invention to practice.

Summary of the Eighth Report of the Carnegie Foundation for the Advancement of Teaching.

THE eighth annual report of the president of the Carnegie Foundation for the Advancement of Teaching, shows a total endowment of $15,325,000, and an expenditure for the year ending September 30th, 1913, of $658,431. Of this $519,440 was distributed in retiring allowances to professors, and $80,949 in pensions to their widows, a total of $600,389. Thirty-three allowances were granted during the year, making the total in force 403, the average annual payment to an individual being $1,703. The total distribution from the beginning has been $2,936,927. The educational work of the Foundation was separately endowed in January, 1913, by a gift of $1,250,000 from Mr. Carnegie through the Carnegie Corporation of New York. This body, which is endowed with one hundred and twenty-five million dollars for "the advancement and diffusion of knowledge and understanding," has five *ex-officio* trustees, of whom one must always be the president of the Carnegie Foundation for the Advancement of Teaching.

In connection with the Foundation's work as a center of information concerning pensions, the president discusses pension systems that are maintained by half a dozen colleges, the development of new systems at Brown University, the Rockefeller Institute, and the American Museum of Natural History, the new federated pension system of the English universities, and the proposed system for the clergy of the Episcopal Church. Among pensions for public school teachers the report discusses the misfortunes of the New York city system, and commends the plans of the new State system in Massachusetts.

Much of the report is devoted to the development of the educational work of the Foundation into a separate Division of Educational Inquiry. Its recent work includes a study of education in Vermont at the request of the Vermont Educational Commission, of legal education at the request of a committee of the American Bar Association, and of engineering education at the request of a joint committee representing the national engineering societies.

The study of education in Vermont, already distributed, represents the first survey that has been made of a State's educational activities as a whole. The study of legal education has been begun by a first-hand inquiry into the bar examinations of every State, a special study of legal teaching by Prof. Josef Redlich, who came from Vienna for the purpose, and by a personal examination of each of the 160 law schools in the country. Plans for the study of engineering education are now being completed. The earlier educational work of the Foundation is continued in the report by commendation

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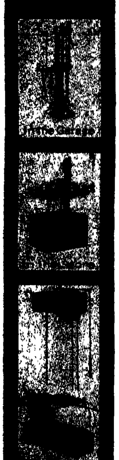

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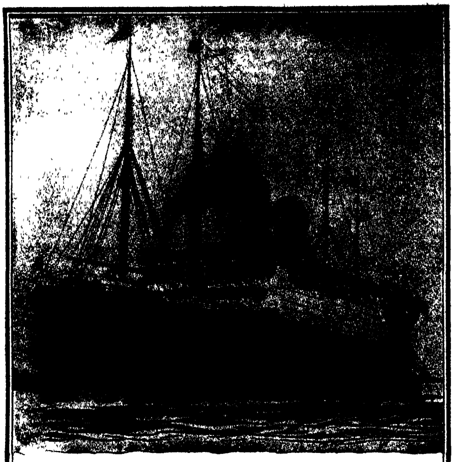

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of the present tendency of college entrance requirements toward both elevation and flexibility. The need for further improvement is shown by the fact that only 55 per cent of the students now in our colleges are high-school graduates. The decrease in the number of medical schools in the country from 162 in 1910 to 115 in 1913, and the rapid improvement of the better schools are commented upon with appreciation. A general study of the problems of the State regulation of higher education is illustrated by a detailed account of the recent crisis in educational affairs in Iowa.

The report further presents a study of the financial status of college teachers as compared with the situation presented in a similar study published five years ago. The ordinary salary of a full professor in the institutions associated with the Foundation is now $3,000. During the last five years the salaries of instructors have risen by about $80; those of junior professors show a gain of from $120 to $225; those of full professors show an increase from $125 to $350.

The report concludes with a frank criticism of contemporary college catalogues. It is accompanied by the annual report of the treasurer.

Alum in Foods

THE much-mooted question of the effects of aluminium compounds on the nutrition and health of man forms the subject of a recent report by the Referee Board of the U. S. Department of Agriculture, the substance of which is published as Bulletin No. 103 of that department. The conclusions of the board are supported by the results of three sets of extensive experiments on human subjects, conducted independently by Dr. Russell H. Chittenden, of the Sheffield Scientific School; Dr. Alonzo E. Taylor, of the University of Pennsylvania Medical School; and Dr John H. Long, of the Northwestern University Medical School, all of whom are members of the board. Although alum is used in making pickles, preparing maraschino cherries, etc., the amount that thus enters into human diet is very small compared with that consumed in baking powders; hence the attention of the board was directed chiefly to the effects of alum baking powders. It appears that "a saline cathartic residue results from the reaction of every known form of baking powder now commonly employed," and when such powders are used in large quantities—e. g., when a person subsists mainly on baking-powder biscuits, as may happen in camp life—the cathartic effect would be noticeable and ultimately injurious On the other hand, the amount of such powders used in an ordinary domestic diet is found to have no such effect, and does not in any way impair the nutritive value of foods. "In short, the board concludes that alum baking powders are no more harmful than any other baking powders, but that it is wise to be moderate in the use of foods that are leavened with baking powder."

A Remarkable Series of Synoptic Weather Charts, showing the meteorological conditions over the southern hemisphere south of latitude 30 S for each day from October 1st, 1901, to March 31st, 1904, has just been published by the Royal Society of London as a volume of the scientific results of the National Antarctic Expedition of 1901-04 The data on which these charts are based were gathered from vessels of all kinds, including exploring ships, as well as from the meteorological observatories and stations of the lands surrounding the Southern Ocean, and cover about one quarter of the earth's surface. No such charts have ever before been published for the southern hemisphere. Their preparation has been in progress for eight years at the Meteorological Office, in London, under the direction of Commander Campbell Hepworth, marine superintendent.

The War Department is reforesting a large area near Fort Bayard, New Mexico, for use as an army hospital site.

LEGAL NOTICES

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If you have an invention which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

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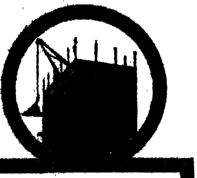

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On Old World Highways. A Book of Motor Rambles in France and Germany, and the Record of a Pilgrimage from Land's End to John o'Groats in Britain. By Thomas D. Murphy. Boston: L. C. Page & Co., 1914. 8vo.; 388 pp.; 16 color plates and 40 duogravures. Price, $3 net.

A most attractive travel book comes to us under the title "On Old World Highways." By far the larger portion of the book is devoted to Great Britain; here the author's treatment becomes most intimate and sympathetic, and we are given some very fine reproductions in color from such canvases as those of MacWhirter and Moran. The viewpoint is one that makes especial appeal to the motorist who is educated, or at least interested, in historic and picturesque values, but much practical suggestion as to roads, hotels, etc., is embodied in the text. There is a large outline map of France and Germany, and others of England and Scotland. The final chapter on "The English and Their Institutions" is sketchy and vigorous rather than profound, but it will serve to correct some prevailing impressions as well as to offer a word of warning to American motorists who have occasion to patronize wayside repair shops.

Hydraulics. A Text-Book for Students and Engineers. By Ernest H. Sprague, A.M. Inst. C.E. New York: D. Van Nostrand Company, 1914. 12mo.; 184 pp.; 89 illustrations. Price, $1 net.

Many of the accompanying diagrams are very crude, though not sufficiently so to be obscure. The text, compiled from standard treatises and lecture notes, is well arranged, and all important principles are ably covered. The author does not scruple to use the calculus wherever convenient; he even hopes that its inclusion may prove of advantage in familiarizing the student with its advantages and in removing the exaggerated fear which the tyro exhibits toward this most important instrument of analysis.

Echappements d'Horloges et de Montres. Exposé Technique, Descriptif et Historique, des Echappements d'Horlogerie. Paris: Bureau de l'*Almanach de l'Horlogerie-Bijouterie.* 8vo.; 263 pp.; illustrated. Price, francs, 4.

This latest volume from the press of Charles Gros is an exhaustive description, from both historical and technical points of view, of those delicate and ingenious mechanisms known as escapements. Every detail of the various types is shown in the 275 cuts that enrich the exposition. Inventors will find a study of the movements and combinations of distinct aid in their work.

Progressive Chemistry. Practical Experiments for Secondary Schools. Prepared by the Teachers of Chemistry in the High Schools of Minneapolis, Minn. Price, 35 cents.

The authors present their material in the form of a writing pad. The upper part of each page is devoted to instructions for carrying out the various simple experiments. The lower portion of the page is blank, for the equations and results of the student. The index shows some forty captions, including tests of water and milk, the determination of simple unknowns, litmus tests and neutralization.

The Fundamental Basis of Nutrition. By Graham Lusk. New Haven: Yale University Press, 1914. 12mo.; 62 pp. Price, 50 cents net.

Prof. Lusk's little book furnishes the clearest exposition we have seen of food values and their relation to the cost of living. The chief aim of the work seems to be to enable the family of small income to select the foods highest in nutriment at the lowest expense. The chapter on beri-beri is in the nature of a digression from this purpose, and it might have been well to have given in its stead a brief discussion of the correct principles of preparing food for the table. So much depends upon the conservation of certain elements, and the bringing out of flavor, that no book on nutrition is complete without some warning of the changes that poor cookery produces in the nutritive values of food.

Bau, Unterhaltung und Verteidigung der Flussdeiche. Von Ehlers, Geheimer Baurat, Professor an der Technischen Hochschule Danzig. Berlin: Wilhelm Ernst & Sohn, 1914. 8vo.; 54 pp.; illustrated. Price, 3.20 marks.

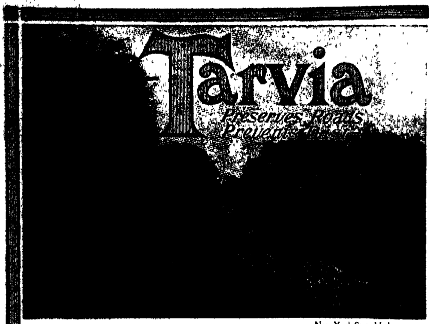
In bringing out this work, the publishers give us another authoritative and valuable discussion. Dikes, levees, and revetment work are made plain by a profusion of charts and diagrams. The control of river water is studied under varying aspects and conditions, and successful constructions are presented for the reader's consideration.

Forged Egyptian Antiquities. By T. G. Wakeling. London: Adam & Charles Black, 1912. Price, $2 net.

Mr. Wakeling's book makes entertaining reading, and will no doubt serve the purpose of placing amateur collectors on their guard. It does not attempt to give positive instructions as to the best manner of detecting frauds, but rather to present its information by citing examples of actual cases of fraud which have come to the author's attention.

India-Rubber Laboratory Practice. By W. A. Caspari, B.Sc., Ph.D., F.I.C. New York: The Macmillan Company, 1914. 12mo.; 196 pp.; illustrated. Price, $1.50 net.

This text is a compendium of practical analytical methods, every one of which has been used by the author, and is vouched for by him as pro-



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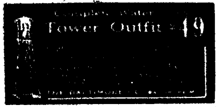

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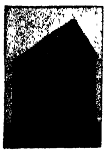

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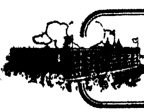

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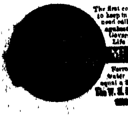

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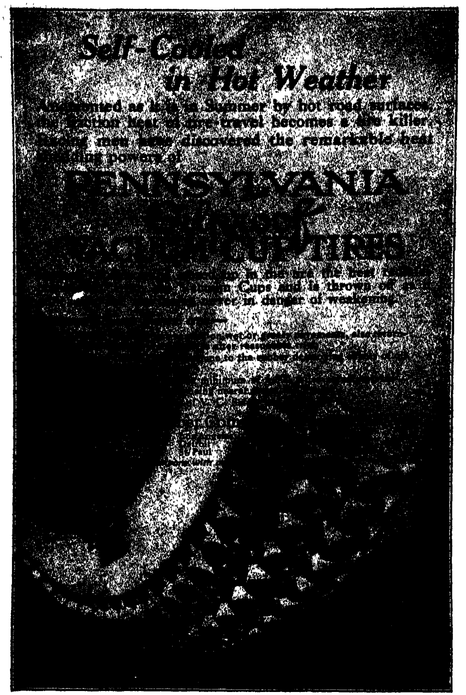

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ductive of satisfactory results. The botanical side of the subject has been practically omitted, as have theoretical chemistry, the production of raw material, and mechanical tests of the finished product. In the special field which it covers, the work will furnish valuable aid to the chemist called upon to deal with India-rubber. Among significant chapters may be noted those on diluents, solid compounding materials, accessories, specific gravities, and analyses of manufactured rubber—both organic and inorganic. Several useful tables are appended.

FLYING. Some Practical Experiences. By Gustav Hamel and Charles C. Turner. New York: Longmans, Green & Co., 1914. Price, $3.50 net.

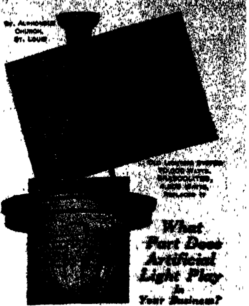
Mr. Hamel and Mr. Turner have written the kind of book which one has the right to expect from practical airmen. It gives us just that insight into the life of a pilot which most works on aeronautics have ignored. That flying is still more or less an acrobatic performance would seem to follow from Mr. Hamel's insistence upon good health and good physical condition. He is one of the few aviators that we know who frankly confess that exceptional steadiness of nerve and extraordinary coolness are indispensable elements in the personal equipment of every airman. It is a pleasure to see that the subject of accidents is not glossed over. Mr. Hamel unscathingly denounces pilots who leave everything to their mechanics and who take desperate chances. Particularly instructive is Mr. Hamel when he speaks of the vagaries of the air. "The air is so sensitive," we learn, "that it is affected even by the color of large patches of vegetation." Mr. Hamel has no illusions about the efficiency of the flying machine and particularly of the hydroaeroplane, as we now know it. "It is highly probable that all the sea-flyers tried in public hitherto are doomed to extinction," he tells us. "The efficient sea-plane is certain to be evolved. Meanwhile no nation possesses it." He bears out the views of the best designers when he says, "Beyond a general belief that all existing float contrivances are unsatisfactory and that a real airboat must be evolved, no one is able to foretell what will be done." While one may take issue with such rash statements as "there is not an aeroplane in the German military service that is not equipped with a bomb magazine and an instrument for sighting and timing," we must commend the book on the whole as a valuable addition to aeronautic literature.

PATENTS FOR DESIGN. By William L. Symons, LL.M., Member of the Bar of the District of Columbia, Lecturer on the Law of Trade-Marks and Patents for Designs, Washington College of Law. Washington, D. C.: John Byrne & Co., 1914. 184 pp. Price, $3 net.

The rapidly increasing importance of the subject of design patents requires that more attention and thought be directed to that branch of law and Patent Office practice confessedly not yet well settled and understood. The need for a treatise in which the provisions of the statutes, regulating the issuance of design patents and the subsequent enforcement of the rights acquired under them, are analyzed and considered in the light of Court and Patent Office decisions, has been supplied by the author. The text is arranged under six main headings, into which this subject can be logically divided for easy reference and study, as follows Design Patent Statutes, Subject Matter for Design Patents, Invention, Novelty and Infringement, Applications and Letters Patent, and Procedure in the Patent Office Under each of these headings, or main divisions, the author has carefully selected and grouped a large number of leading and decisive decisions rendered by the courts and the Patent Office, with a clear and full discussion and analysis of the most important of these. In grouping the decisions which are controlling on one or another feature of Design Patent Practice, the author was guided by the belief that the opinions expressed by the courts and writers on this subject, if held up and examined side by side and the exact points of existing differences noted, would lead to a clearer and better understanding of the particular questions involved. This book is but the third of its kind published in this country, the second appearing in 1889, of which Hector T Fenton, Esq , of the Philadelphia Bar, was the author The pioneer work was written and published in 1874 by William E. Simmonds, former Commissioner of Patents. There can be little doubt but that "Patents for Design" will meet with favor at once, and that it will be of inestimable value to all interested in its subject matter.

LA LUMIÈRE ELECTRIQUE ET SES DIFFERENTES APPLICATIONS AU THEATRE, installation et entretien. Par V. Trudelle, électricien. H. Dunod et E. Pinat, Editeurs, 47 et 49 Quai des Grands-Augustins, Paris, VI. In-8 de vi-295 pages, avec 80 fig. Broché, 10 francs; Cartonné, 11 fr. 50.

M. Trudelle has written a very practical book on electrical theater lighting for the architect or stage manager. There are only too few books upon a subject which is unfortunately still regarded as recondite The illuminating engineer has been so diligent in attacking the problem of house lighting that he has not as yet devoted much attention to stage illumination. Even if he were to do so, it is doubtful if he would succeed very brilliantly; for the illumination of the stage demands a technique of its own and a knowledge not only of electrical engineering, but also of theatrical effects. The author has had a very wide experience which is reflected in every chapter of his book. He discusses not only the effects to be sought, but also the machinery by which the effects are obtained.



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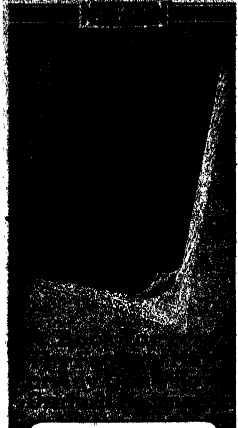

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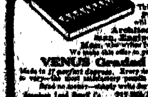

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Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

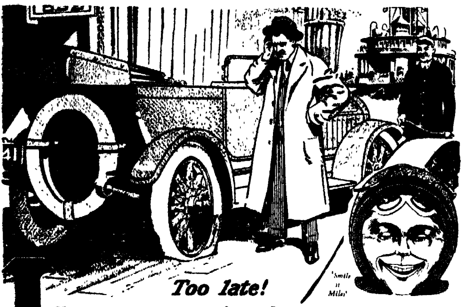
(12994) G. A. asks: As a reader, subscriber and admirer of your valuable paper, I now ask if there is any publication dealing with the contortion of vines. Surely enough they wind *from left to right in our hemisphere (going up)* Do their twists decrease nearing the equator, and then reverse from left to right to right to left? A. The twining of plants is treated in the botanies. It is usually the case that the same plant twines in the same direction at all times, but there are said to be plants which twine indifferently in either direction. All plants in our hemisphere do not twine with the sun, or from left to right. The morning glory twines in the opposite direction. It is said that plants in the torrid zone reverse their direction of turning quite frequently We have no information about this feature of plant life in the southern hemisphere. The phenomenon is called circumnutation

(12995) E. T. O'H. asks: If a person was at sea at 1,000 feet altitude, how far could he see? A. In the best table we have, the distance to which vision will extend from an altitude of 1,000 feet is given as 38.41 miles

(12996) S. R. asks: In the new edition of J Todhunter's "Algebra for the Use of Colleges and Schools," on page 438, is an enunciation of Fermat's Theorem which is as follows: If n be a prime number and N prime to n, then N^{n-1} is a multiple of n On page 439 of said book, paragraph 716, is a full and complete demonstration of said theorem. In query 12980 of April 18th, 1914, what is called Fermat's Theorem there only bears a small resemblance to the theorem as enunciated by Todhunter and assigned to Fermat, though on further investigation I may change my mind A. In reply to your letter we would say that Fermat had the habit of writing his observations upon the margins of the pages of the books he was reading, and in this way enunciated a large number of new statements upon many topics in mathematics The theorem which we quoted is known as Fermat's Greater Theorem, as we stated in our note, and to this and this alone the prize offered refers; it does not refer to any theorem which has already been solved You will note that the periodical from which we abstracted the conditions is the highest in authority in America, and doubtless the information given is reliable

(12997) W. R. L. says: I purposely asked that my question be submitted to your astronomer. I was under the impression that it was generally admitted that the earth being carried near hotter suns than ours, or, on the other side of it, being carried into regions remote from large and hot suns, was responsible for those great changes in the heat of the earth So I put it up to Mr Astronomer. I can't get away from the idea that some sudden change in temperature must be responsible for the imprisonment of the big animals in the ice in such perfect state of preservation as to have the food recently eaten still intact in the stomach A The writer of our reply to your former letter was our astronomer, not the one who prepares the monthly article, but the one who for many years has written all the replies to astronomical queries, so that his opinion is not that of a geologist, but of an astronomer. He would further say that no astronomer holds the view that the earth ever has been nearer to any other or hotter sun than the one around which it now revolves. Nor do astronomers believe that the earth could go near to such a sun and ever return to its orbit around our sun again. On the other hand, geologists have entirely abandoned the theory of sudden catastrophes, such as would catch and imprison a mammoth in the ice with the food in his stomach. He was caught in the ice, to be sure, but just as a climber to-day might be and lose his life with his undigested food in his stomach. Scott's "Geology," page 527, declares the doctrine of Catastrophism to be erroneous. Dana's "Manual of Geology," page 978, says that the elevation of the land in high altitudes is a sufficient cause for the glacial period. He does not even allude to the theory of catastrophes. No geologist or astronomer holds that sudden changes in the earth's climate have ever occurred.

(12998) I. C. McG. asks: Is there a school anywhere where children are taught the "sense of weight," so that they may know how much a pound or two pounds or five pounds are, just by the sense of weight, without having scales for proof? Why not have a grocer's clerk that can size up a package just as exactly as a bank cashier can size up a stranger? The child now is taught many more things than most of them can realize or profit by, but among them are many subjects no more important than the sense of weight. A. We quite agree with you that it is desirable to practice in the estimating of weights, but we do not think any such accuracy can be acquired as in the estimate of length by the eye. It does not seem possible that one can estimate a pound as accurately as a foot. Sensation in the eye is much more acute than the sense of pressure



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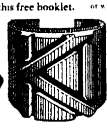

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upon a muscle, or the tension of a muscle. We should prefer the indication of the scales to the judgment of even an honest grocer's clerk in buying butter. There are schools in which weights are enclosed in boxes all of the same size and outward appearance, but the weights differ, and the student is to determine the weight. Such exercises are advantageous in developing the judgment of the student, and should be extended.

(12999) C. H. asks: I wish to ask if you can give me answers to the questions below or tell me in what book I can find them 1 How can the force against an object exerted by the impingement of a ray of light be calculated, and how measured? A. You will find an abstract of a lecture by Prof Nichols, who succeeded in measuring the pressure of radiation, in our SUPPLEMENT No. 1539, and other valuable articles upon the same subject in SUPPLEMENT Nos. 1525, 1814 and 1958, which we will send for ten cents each, mailed 2 Where can I get a radiometer (one of those glass affairs containing a vane-wheel which spins when exposed to light) and what is the cost of one? A. You can buy a radiometer from any dealer in physical apparatus. 3 What books or papers have you for sale on selenium cells and transmission of light? A We can furnish you with many papers on selenium We name SUPPLEMENT Nos. 1430, 1719, 1912, 1881, 1882, 1883, 1897, 1914, and the SCIENTIFIC AMERICAN, Vol 102, No. 8, and Vol. 107, No. 21; price, 10 cents each, mailed.

(13000) F. M. H. asks: Desiring to gain the date of a few modern inventions, I have been recommended to you Can you give me the date and name of the inventors of the following Steam power, electricity as a power, telegraphy, the first steam vessel? I would like the date of the first alphabet. A As a rule, the dates of the "first use" of most things are involved in much obscurity, since no note is taken of such matters at the time Their importance is not realized by the persons engaged in the events The history of the steam engine is given in the "Encyclopædia Britannica," vol 25, page 818, which you may find in your public library The earliest use of steam for power is described by Hero of Alexandria, about 130 B. C The first useful steam engine is usually ascribed to Edward Somerset, at least its description, though perhaps not its construction, in 1663. The first commercially successful engine was that of Thomas Savery, patented in 1698, in England Newcommen followed in 1705, and in 1763 Watt so improved Newcommen's engine as to make it really a different machine, and from Watt the modern steam engine is usually dated But it was not till 1829 that the locomotive was successfully brought out by George Stephenson, though many competitors were in the field The early inventors of steam propulsion on the water are given in SCIENTIFIC AMERICAN, vol. 101, No 13, price ten cents You will find in that paper cuts and descriptions of the performance of Johnathan Hull's steamboat, 1737. A letter of a correspondent regarding this boat in the SCIENTIFIC AMERICAN, vol. 101, No 18, which goes to prove that this boat was built and performed real work, should be read. This seems to have been the first steamboat Between 1780 and 1807, the date of Fulton's "Clermont," there were other steamboats built, in America and Europe, which are pictured in the paper referred to above. You will find these fully described in Thurston's "Growth of the Steam Engine," which we send for $2 50 postpaid The first practical recording telegraph instrument was that of Morse, in 1835, to whom we also owe the dot and dash alphabet. The first use of electricity for power was when an electromagnet was used to lift a weight, the date of which is not known It might be claimed that the first time rubbed amber lifted a piece of thin paper, about 600 B C, should be taken as the proper date for this The first motors were run by batteries and antedate the invention of the dynamo. Possibly the first electric motor was that of the Abbe Salvatore del Negro in Italy in 1830. Thomas Davenport, a blacksmith of Brandon, Vermont, in 1835 constructed a car which was run by a motor operated by a battery, which was carried on the car The early efforts in the line of electric railways are given in the "Encyclopædia Britannica," vol 27, under the caption Traction. Our alphabet is derived from the Greeks, and they are believed to have obtained their letters from the Phœnicians The date of this is not known.

(13001) L. B asks: On the night of April 13th, on a farm about ten miles outside Johannesburg, I witnessed a perfect lunar rainbow It was a dull white in color, and near the original there appeared the lower part of a second bow As a reader of your paper, I should be glad to know if this phenomenon would appear under similar conditions, i e, a rain squall beating up from the west and the moon rising in a clear sky in the east, in any part of the world, or whether it was due to the nature of the atmosphere here, as Johannesburg is situated 6,000 feet above sea level A Lunar rainbows are not common, nor can they be called very rare. The writer has seen several. They are as you describe, not bright enough to show the colors of the solar rainbow, unless a faint red and yellow They are sometimes seen at sea, and the altitude of the place would have no influence in their formation

(13002) H. K. asks: Some years ago, I recall reading an article in the SCIENTIFIC AMERICAN on the processes of metalizing flowers and insects. I am anxious to know the process, and would like to know if you can furnish the formulas and working knowledge, or advise me where I can get it? A. You will find instructions for electroplating flowers and other soft objects in the SCIENTIFIC AMERICAN, vol 99 No 22, and in SUPPLEMENT, Nos. 1716 and 1749, price ten cents each, mailed. Fuller instructions are given in Watt's "Electro-Plating," Chapter VI, which we send for [illegible] postpaid.

(13003) R. E. W. asks: Does the moon have any effect on the growth of vegetables? Does it make any difference when potatoes are planted in reference to the moon? I have been told by several successful farmers that the time to plant potatoes was in the dark of the moon. If planted in the light of the moon, they would all grow to tops. Does the moon have any effect on the killing of pigs for pork? Some claim that if killed during a certain time of the moon the meat will all curl up when fried, other times it will not. Does the moon have any effect on the weaning of children or stock? This all sounds very foolish to me, as I can see no connection between the moon and garden stuffs or pigs and children The moon is there all the time, but the people I talked with were very indignant when I doubted them. A. There is not a shadow of evidence of a scientific nature to show that the moon has the slightest influence on the weather, or the growth of potatoes, or the cooking of pork, or the weaning of stock. When you think of it that thousands of hogs are killed every day in the year, moon or no moon, in the large slaughter houses of the West, it is evident that the packers have no respect for the moon in selecting a day for the killing of hogs. In the other matters of your inquiry, the same is true. Men do not generally look to the moon for portents for planting They plant when the ground is in the proper condition

(13004) A. J. deF. asks: In your issue of May 2nd, 1914, page 368, Mr. Henry Norris Russell says, "at a distance of 1,255 astronomical units, or 117 million miles." J. H Poynting in "The Earth," page 36, says, "Astronomers use as the unit the distance which light travels in one year at the rate of 186,000 miles per second, or 5.8 million million miles" Please set me clear about this. A. Your difficulty as to units in astronomy is easily adjusted. Both Prof. Russell and Prof. Poynting are correct, since they are referring to different units. The "Astronomical Unit" is the mean distance of the earth from the sun, and this is used in expressing distances in the solar system. Its latest determination is 92,877,000 miles. Prof. Young in his "Manual of Astronomy," page 497, says, "The distances of the stars are so enormous that the radius of the earth's orbit, the astronomical unit hitherto employed (meaning by hitherto, in his book thus far) is too small for a convenient measure. It is better, and now usual, to take as the unit of stellar distances the so-called 'light year,' i e., the distance which light travels in a year." Now referring to Prof Poynting's book, page 36, it is evident that he is referring only to the unit of the stellar distances, and not to distances within the solar system, with which Prof Russell was dealing in the article referred to above We trust this makes the matter clear. We express short distances in feet, longer ones in miles. In just the same way the Astronomical Unit is used for the relatively short distances in the solar system, and the Light Year for the spaces between us and the stars.

(13005) J. M. asks: I wish to know how to keep flowers that are cut from withering so fast. Is there anything that can be put in the water, or some special treatment? A It has been said that flowers will keep much longer without fading, if a little ammonium chloride is put into the water in which they are placed The cut ends should be fresh when the flowers are put into the water. An end of a stem which has been seared and dried cannot absorb water, and the flower must fade. It is best to cut the stems off under water and not allow the air to strike them at all The protoplasm of the plant is very sensitive, and it is upon its power to imbibe water that the life of a plant depends.

(13006) R. W. N. asks: Please let me know what you know about cleaning silver and gold by the use of a small zinc plate to which a strip of tin is attached I have used this successfully in cleaning silver in a granite pan, but to-day a man informed me that if a person used a pan made of any other metal than zinc, the silver on the ware placed in the vessel to be cleaned, would be removed and deposited on any part in the pan in which the base metal was exposed. For instance, if the enamel happened to be off in some spot, and the iron exposed, it would plate the iron over with silver removed from the silverware; and if a tin vessel was used, if there was a spot where the iron happened to be exposed, the silver would be plated over it and would continue to plate and replate over the silver already deposited thereon, thus removing silver from all silverware placed in such a pan with the zinc plates for cleaning. A. In the use of the silver and gold cleansing process, it is necessary to have a metal dish, or better a metal plate in an earthen dish, which is electro-positive to silver. It is not difficult to find such metals, since silver and gold are negative to most of the metals. Presumably, most of the solutions employed contain nitrate of silver, which is deposited on the silver article by electrolysis, a feeble current being set up in the liquid Thus a plating action is produced. The list of metals given in the "Standard Electrical Engineers' Handbook," price $4, is as follows: Aluminium, zinc, tin, lead, iron, copper, silver, gold. Any metal which precedes silver may be used, but the farther away from silver the metal is in the list, the stronger the action will be. From this it is seen that aluminium is the best metal to be had for the plate, and zinc is the next in value. It is also to be seen that the plating action would not be reversed by the use of iron or steel in the dish in which the plating is carried on. It is more common to use an earthen dish and to place in it a sheet of aluminium, with which the silver articles are brought into contact.

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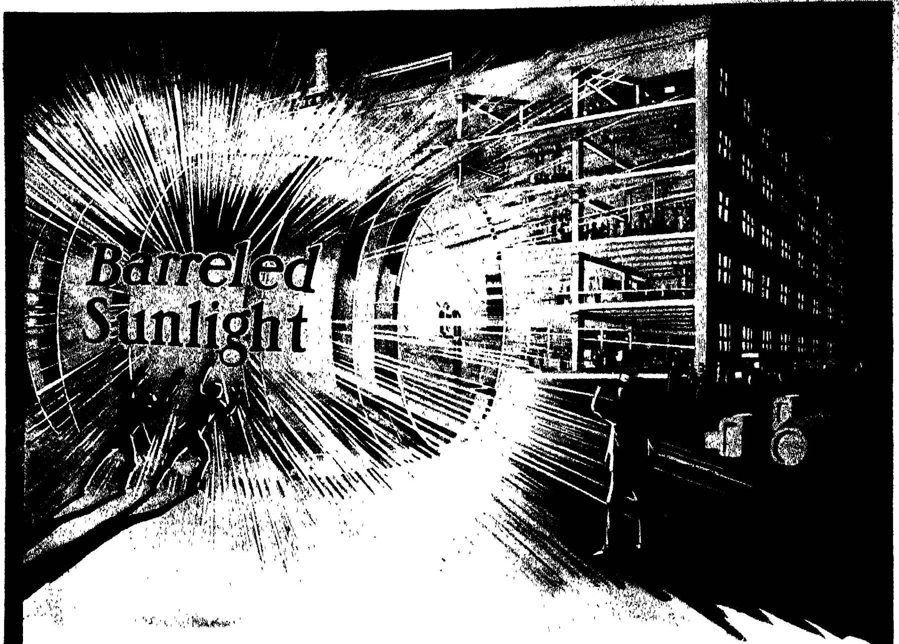

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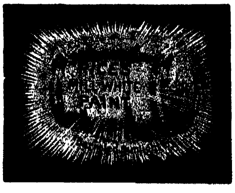

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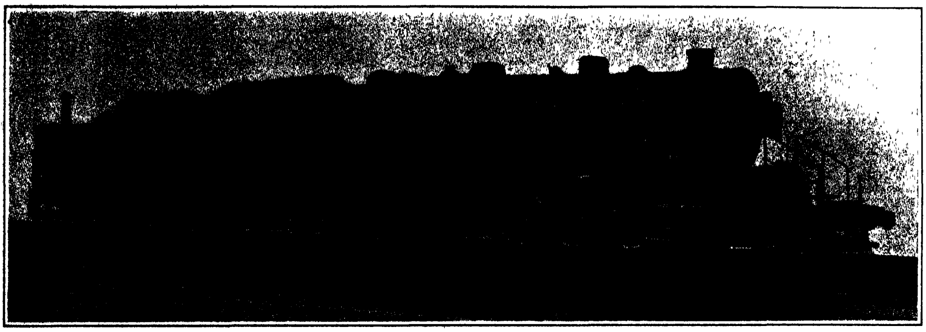


The Erie "pusher," largest locomotive in world. Weight, 853,000 pounds; tractive effort, 160,000 pounds.

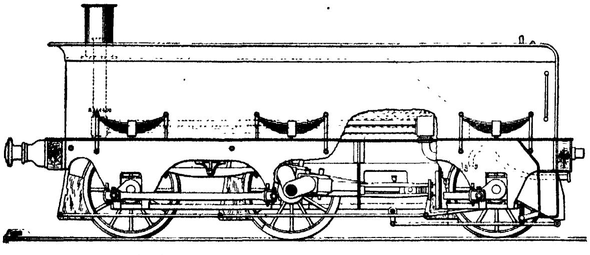
The World's Largest Locomotive

THE engineers and naval architects are doing some big things in the way of construction just now, as the recent arrival of the "Vaterland" and the "Aquitania" at this port has shown; and the illustrations which we present of the great Erie freight locomotive give evidence that in that other great field of transportation, the railway, the engineer is also building in ever-increasing sizes and weights. This most interesting locomotive has recently been completed for the Erie Railroad from designs by G. R. Henderson, consulting engineer of the Baldwin Locomotive Works. It is the heaviest and most powerful locomotive ever constructed, its total weight being 853,050 pounds. The greatest advance of this over existing freight locomotives has been in the matter of tractive effort. Hitherto the most powerful freight locomotive was what is known as the Virginian Mallet, which, when working compound, has a tractive effort of 115,000 pounds. The tractive effort of the new Erie locomotive is 160,000 pounds, or a direct pull on the drawbar of eighty American tons. The locomotive has been built for the pusher service on an 8-mile stretch of grade east of Susquehanna, Pa., which has an average rise of 56 feet to the mile. The new locomotive, which is known as the Triplex Compound, will take the place on full tonnage trains of three separate pushers, as now used.

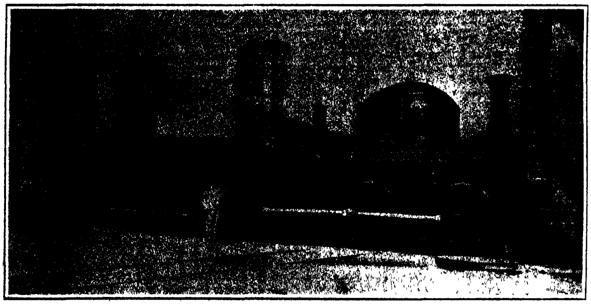
It will be seen at a glance that the novelty in this locomotive consists in the fact that, in addition to the two separate engines placed under the locomotive proper, which are the characteristic feature of the Mallet type, a third engine has been placed under the tender, whose weight is thus brought into service for tractive effort. An interesting feature is the fact that the three locomotives with their sets of coupled drivers are identical in dimensions, all cylinders being 36 inches in diameter by 32 inches in stroke, and all having 16-inch piston valves and the Baker valve gear. Steam at a pressure of 210 pounds to the inch is led to the central pair of cylinders. The exhaust steam from the cylinder on one side is led to the forward low-pressure pair of cylinders, and that from the cylinder on the opposite side is led to the after pair of low-pressure cylinders. The ratio of expansion is therefore 1 to 2.

The boiler is of enormous proportions. At the front end it is 94 inches in diameter and at the dome ring 108¼ inches in diameter. The firebox, of the radial stay type, is 162 inches long and 108 inches wide at the mud ring. The locomotive is fired by a mechanical stoker. Superheated steam is used, of course, and the Schmidt superheater, the largest ever applied to a locomo-

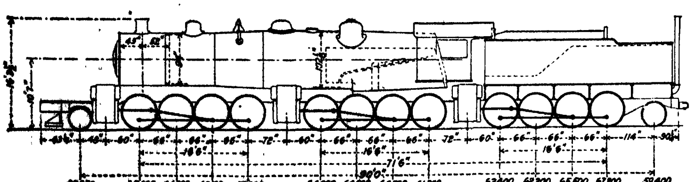
(Concluded on page 492)



Sectional view, showing engine and condenser on tender.



Old photograph of a Sturrock engine of 1863, with auxiliary engine under the tender.



Courtesy of Railway Age Gazette.

Diagram showing arrangement of cylinders and coupled drivers of Erie locomotive.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The One Great Lesson of the St. Lawrence Disaster

IN the case of great calamities, such as the sinking of the "Empress of Ireland" with a loss of over 1,000 souls, there is a danger that the one great lesson of the disaster may be lost sight of in the consideration of questions of relatively minor importance. The alarming fact in this case is that this comparatively new and very fine ship went to the bottom in *fourteen minutes after the collision.*

The large modern passenger steamer carries a small townful of people. In the designing of such a ship there are many requirements to be met, but there is one requirement which in importance transcends all the others, and this is that, if from two to five thousand people are to be committed to her keeping, and she is to be sent across many thousand miles of ocean water, she should be so built that she is practically unsinkable.

Let us suppose that no such vessel had ever been constructed, and that, *to-day*, for the first time, the problem was put up to the naval architect and the engineer to provide a 20-knot ship capable of carrying several thousand people across the Atlantic. It is perfectly certain that, if no restrictions of a commercial kind were imposed upon him, the designer, realizing the priceless value of the human freight that was to be committed to her care, would see to it that her construction was such as to render her practically unsinkable by any of the accidents of ocean travel. Having built her so, he would then proceed to provide the necessary accommodations for boilers and engines, and for the housing and comfort of her passengers and crew. As a matter of fact, when the first of the great ocean liners, the "Great Eastern," was under consideration, her designers, Brunel, the engineer, and Scott Russell, the naval architect, did make this the first consideration. They built the ship with a double hull, one within the other, with a suitable space between them, said space being divided and subdivided into a multitude of watertight compartments. This double hull extended from stem to stern, and it was carried some ten to twelve feet above the water-line, at which point it was covered in by an iron, watertight deck. The double hull as thus provided was subdivided by a large number of stout watertight bulkheads extending transversely across the ship. Also there were run longitudinally through the ship, two bulkheads which served still further to subdivide the transverse compartments.

Unfortunately, this great ship was ahead of passenger and freight traffic requirements of her day; she could not get a sufficiently large passenger list nor sufficient freight to make her a paying proposition. There was a return to smaller ships, but most unfortunately for the safety of ocean travel, the ocean liners, built from her day on, were constructed without that proper and very solicitous care which Brunel exercised in the endeavor to make this ship safe and practically unsinkable. That Brunel was satisfied that he had succeeded in building a safe ship is shown by his "notes on the strength and safety of the 'Great Eastern,'" which he prepared for the stockholders and directors just before her launching, in which he said, "No combination of circumstances, within the ordinary range of probability, can cause such damage as to sink her."

In the forty years of shipbuilding succeeding the day of the "Great Eastern," the shipbuilder eliminated many of the structural elements which made that fine ship so safe. The double hull was confined to the bottom of the ship, the sides, from the turn of the bilge up, consisting merely of a single thickness of plating. The longitudinal bulkheads were omitted, as were also the watertight decks.

Now, so far as the saving of the lives of the passengers is concerned, the double bottom is not so important as the double sides. As a rule, in case of puncture of the outer shell through running upon rocks, the ship remains afloat and the passengers can be saved; but in the event of a rupture, as in the case of the "Titanic," of the single shell plating at the sides of the ship, experience shows that if the damage be extensive, the ship is doomed.

As matters stand to-day, only a few of the large ocean liners engaged in the Atlantic trade embody the principles of safety which Brunel put into the "Great Eastern." The "Kaiser Wilhelm der Grosse" and the "Cecilie," of the North German Lloyd, are so built, as are also the "Imperator" and the "Vaterland" of the Hamburg-American Line. The "Olympic," after the disaster to the "Titanic," was rebuilt at a cost of a million dollars, and she now carries an inner skin, lofty bulkheads, and watertight flats below the water-line. She is now a safe ship. The "Mauretania," "Lusitania," and the new "Aquitania" of the Cunard Line are safe; for they too have been provided with an inner skin in the shape of the inner walls of the coal bunkers, which extend throughout the greater portion of the length of the ship. The new "Britannic," due here in the Autumn, will carry an inner skin. Outside of these ships and perhaps a few others, practically the whole of the fast and large passenger-carrying ships on the Atlantic and Pacific Oceans are without an inner skin, and in case of serious collision, are liable to suffer the same fate as the "Empress of Ireland."

In our last issue we drew attention to the very serious fact that, although the recent London International Conference on Safety at Sea advocated higher transverse bulkheads terminating in a watertight deck, it did not, as it should have done, specifically call for the provision of some form of inner skin. We consider that it is a great misfortune that this distinguished board was not composed more fully of purely technical men—naval architects and engineers—who would have considered the question of making ships absolutely safe upon its technical merits and without a too tender regard for the first cost of construction. It is not too late to make the necessary change before the Convention is ratified. The cost of inner-skin construction is not prohibitive by any means, and if it will prevent, as it certainly will, such sudden and wholesale snuffing out of the lives of passengers as occurred in the "Empress of Ireland," considerations of humanity demand that inner-skin construction, in some form or other, should be made absolutely obligatory in the case of ships that carry large passenger lists.

Where the lives of a whole townful of people are concerned, the ships that carry them should be made fool-proof. This can be done; for it is a mere matter of mechanics and construction. Certain it is that the human element and all the risks which come with it can never be eliminated. When two ships, such as the "Empress of Ireland" and the "Storstad," which sight each other some two miles apart, and are in constant conversation during a passing fog-cloud, through well understood signals, nevertheless blunder into an inexcusable collision, surely it is time for the public to demand that the ships in which they trust their lives shall be made fool-proof. Throughout the whole of the official investigations which will be made of this terrible calamity, for Heaven's sake, let everybody, from Lord Mersey down, bear in mind the fact that the great lesson of the calamity is that we must safeguard against the frailty of the human element by making such horrors as this *mechanically* impossible.

Lightning Protection for Dwellings

EVER since Benjamin Franklin invented the lightning-rod our ideas as to what constitutes effective protection for buildings have undergone constant revision. The cheap and improperly installed lightning-rods sold to farmers by enterprising agents were soon found to be worse than useless, and, in the reaction that set in against them, the modern dwelling house has usually been left without any protection. This has developed a situation that is both critical and serious, because we are now building our houses in such a way as greatly to increase the hazard that existed heretofore.

The modern skyscraper seems to have worked out its own salvation, because it is constructed on correct principles. *Its massive steel frame, its metallic roof, and its grounded conductors form a lightning protection that is as perfect as could be desired.*

In the modern suburban house, on the other hand, we are persistently violating the principles that have made *the skyscraper so safe, and the increased damage that* has resulted abundantly testifies that we are paying the penalty for such infraction of Nature's laws. Houses of the class mentioned are seldom provided with metallic roofs. Shingles, slates, and asbestos shingles are the predominating materials, and the leader pipes frequently terminate several inches above the ground. These things in themselves, however, do not constitute the increased hazard to which reference has been made. This comes from the steam or hot-water heating system, where we construct within the shell of the building a system of massive conductors running from cellar to attic. These pipes are, for the most part, very straight, *forming paths of low impedance* to the passage of high-frequency discharges, and they are also directly connected to the underground piping of the water-works system, which forms a most effective "capacity ground." A more attractive path for a lightning discharge it would be difficult to imagine, and yet how can the lightning take advantage of it? *Only by puncturing the roof or side-walls of the building and probably setting them on fire!*

The writer has seen so many buildings damaged in just this way that he is moved to point out the danger, and to suggest as a remedy that such a heating system should be provided with at least one or, preferably, several pieces of pipe extending from the top-floor radiators straight up through the roof and terminating with capped ends. It would seem, from careful consideration of the various factors involved, that the danger will, by this expedient, be greatly lessened.

Climatic Fluctuations

THE study of real or supposed changes and oscillations in climate possesses a peculiar fascination for many minds, if one may judge by the flood of literature that has appeared on this subject. The idea that the climate of any region has definitely and permanently changed within a generation or so, although firmly fixed in the mind of the average layman, is not held in honor in scientific circles. On the other hand, few meteorologists have been able to resist the temptation to hunt for periodicities, correlations, and the like, in the ups and downs of climatic curves from year to year, and to seek the clue to these fluctuations in such far-reaching agencies as variations in solar radiation, volcanic eruptions, or what not. Such investigations, however, are often vitiated by hasty assumptions from the records of a limited number of stations as to what has occurred in the world as a whole. In order to know, for example, whether world-temperatures fluctuate in the same way as the sunspot period, we must have before us some accurate delineation of these temperatures which will not obscure the fact that a warm year in Europe may coincide with a cold year in South America, and so forth. It probably never happens that the temperature of the whole world is above normal at the same time; what we have to deal with, in investigating world-temperatures, is variations in the size and intensity of the regions in which excessive temperatures *do* occur. These are what Mr. Henryk Arctowski has called "pleions," and his method of charting the pleions of temperature and other elements from year to year is one of the most fruitful devices known to meteorology. First set forth in his "Enchainement des variations climatiques" (Brussels, 1909), it has been utilized in this author's numerous contributions to the *Bulletin of the American Geographical Society* and other journals. His latest study of "pleionian" variations appears in the *American Journal of Science* for April, 1914.

Temperatures of the Stars

DURING two years, Rosenberg has studied photographically the spectra of the seventy most brilliant stars in the northern hemisphere, from the first to the third order of magnitude. By a comparison of their spectra it is possible to deduce their temperatures. The results obtained agree well with those of Wilsing and Scheiner; stars of the helium type are the hottest, and the red stars are the coolest. As a specimen, the following temperatures are quoted: Sirius, 27,000 degrees; Vega, 22,000 degrees; Algol, 12,000 degrees; Arcturus, 3,000 degrees; Aldebaran, 2,000 degrees.

From the aspect and relative displacement of the spectral lines an idea may be formed of the pressure conditions in the atmospheres of the stars studied. Thus Adams has found that in the light-emitting atmosphere of Sirius the pressure is twelve times that existing in the solar photosphere, which confirms the hypothesis that Sirius is a simple mass of gas, without a defined surface of condensation.

William A. Carroll

IT is with much regret that we announce the death of Mr. W. A. Carroll, who, for many years, was connected with the advertising department of the SCIENTIFIC AMERICAN as its Western representative, which field he covered in a most satisfactory manner, making for himself a high record of efficiency in this work. His close attention to business, genial manners, and good-fellowship gained for him a host of friends in the West, who will, we are sure, regret with us his untimely demise.

Engineering

Proposed Inter-terminal Line at St. Petersburg.—According to the Engineer, it is proposed to construct a belt line of railway connecting up the various lines entering the city of St. Petersburg. The line will serve for the transfer of merchandise and passengers from one railroad system to another, and the total length will be about 53 miles.

High Speed on a Maiden Trip.—During her maiden trip to this port last week, the new Cunard steamship "Aquitania" steamed during a single day 602 miles, an average of 24.24 knots. On her trial trip she averaged for a few miles slightly over 25 knots. The fastest average for the whole Atlantic trip of 26.06 knots was made a few years ago by the "Mauretania."

President Wilson on the Merchant Marine.—After a call of the National Foreign Trade Convention at the White House the President was quoted as saying: "I am sure that I speak the conviction of all of you when I say that one of our chief needs is to have a merchant marine. Because we have to deliver our goods in other peoples' delivery wagons their goods are delivered first and our goods are delivered incidentally on their route."

Railway Accident Statistics for Three Months.—During the three months ending September 30th, the Interstate Commerce Commission states that 211 passengers were killed and 4,011 injured in train accidents in the United States. At this rate the total for the year would be 844 killed and over 16,000 injured. The accident *Bulletin* says that 67.6 per cent of the derailments were due to defective equipment and defective roadbed.

The Spaciousness of Modern Liners.—As showing the spaciousness of the largest of the modern ocean liners, attention is drawn to the ballroom on the "Vaterland," which is 80 feet in length, 58 feet in width and 21½ feet in clear height. In spite of its great span, this room has no supporting columns whatsoever, the roof being carried by overhead girders, extending from side wall to side wall. The dining-room is 135 feet long, upward of 100 feet in width, and it has a maximum height of 30 feet.

Cost of Panama Canal in Lives.—In a letter to Hon. George M. Young, Representative in Congress, Col. Goethals states that from May, 1904, to March, 1914, 1,219 lives were lost on the Panama Canal through accidents. This total covers only those deaths which resulted from accidents happening on the work, except that it includes 167 deaths from accidental drowning, all of which did not occur on the work. From August, 1908, to March, 1914, the accidents resulting in injuries reached a total of 25,101. Mr. Young called the attention of Congress to the fact that the loss of life through accidents, as here recorded, was greater than that during the war of 1812, or during the Mexican war.

A Difficult Engineering Feat.—What is considered one of the most difficult bridge engineering feats yet attempted was the removal from the Williamsburg Bridge trusses of the existing end pins and the substitution of larger pins, without seriously interfering with the traffic. For some time reconstruction of the floor system of the bridge has been under way, in preparation for the heavy subway trains of the Dual Subway System. As part of this work it was necessary to remove the existing 10-inch pins from the trusses at the towers and substitute 13-inch pins of nickel steel. These pins are 40 inches in length and weigh 1,500 pounds. It was necessary to drill out the ends of the steel girders to the enlarged dimensions before inserting the pins.

The Hydro-Aeroplane at Vera Cruz.—Capt. Washington I. Chambers, U. S. N., in a lecture to the members of the University Club of Washington, stated that the hydro-aeroplanes had proved their usefulness in military operations around Vera Cruz and elsewhere. Particularly had they shown their value in ascertaining whether or not harbors were mined. The captain stated that not only is it possible to see mines plainly, but they can be easily photographed from the aeroplane. Recently, mines were planted on the Pacific Coast and the commander of the Pacific fleet was notified to that effect. The aeroplanes were sent out to search for them, the aeronauts having no information as to the vicinity in which they could be found. Nevertheless, they had no difficulty in locating the mines.

A Suggestion in Economy.—According to the *Railway Gazette*, an American railroad recently sent a train over its system to collect scrap material and odds and ends of every kind, the train carrying a divisional superintendent and his staff. Scrap and obsolete material was collected to the amount of 147 car loads, valued at $42,000, and after deducting the cost of labor, train expenses, etc., there was a net gain of $39,000. As showing the conditions, twelve bottles of ink were found at a small station where one bottle would suffice for a year, and at another point fifty non-insulated bridle rods were found at a station on territory which was track-circuited throughout. Useless at such points, these materials were serviceable elsewhere.

Science

Dr. Richard Assmann, the dean of German aerologists, has retired from the directorship of the aeronautical observatory at Lindenberg, where he is succeeded by Prof. Hergesell, late of Strassburg.

The Edward Longstreth Medal of the Franklin Institute has been awarded to Prof. William J. Humphreys of the United States Weather Bureau, for his paper on "Volcanic Dust and Other Factors in the Production of Climatic Changes and Their Possible Relation to Ice Ages."

Coins for a Leper Colony.—The Philippine government has minted a special coinage for use in the Culion leper colony. The coins are of aluminium, and include pieces of one peso, and twenty, ten, five, one and one half centavos. They are accepted at face value for all business carried on within the colony, but are of no value elsewhere.

An Encyclopædia of the German Colonies is in course of preparation under the general editorship of Dr. H. Schnee, governor of German East Africa, and is to be published in Leipzig. About seventy specialists will contribute articles on colonial politics, geography, ethnology, geology, mineralogy, zoology, mining, agriculture, communications, missions and all other topics connected with Germany's great colonial empire.

Agricultural Meteorology in France.—The project of establishing an office under the French government devoted to the study of agricultural meteorology (distinct from the Bureau Central Météorologique) has been under discussion for several years. A technical commission on this subject has at last been established by a ministerial decree of January 6, 1914, as a branch of the Direction Générale des Eaux et Forêts, under the Ministry of Agriculture. It consists of thirty members, who are nominated for three years.

A Daily Wireless Weather Bulletin for the Great Lakes was inaugurated by the United States Weather Bureau on June 1st. It is distributed broadcast by the naval radio station at Radio, Va., a few minutes after 10 P. M., immediately after the bulletin for the North Atlantic and Gulf of Mexico, which has now been sent out daily for some months. The new bulletin, which is for the benefit of mariners on the lakes, gives the weather conditions prevailing at 8 P. M. of the current day at Duluth, Marquette, Sault Ste. Marie, Green Bay, Chicago, Alpena, Detroit, Cleveland and Buffalo, and a forecast of wind and weather conditions for the upper and lower lake regions for the following 24 hours.

An International Hydrographic Campaign in the North Atlantic Ocean is planned in connection with the formal opening of the Panama Canal. At the suggestion of Prof. Schott of the Deutsche Seewarte, all European countries that are to send men-of-war to Panama for the opening ceremonies have been asked to make a complete hydrographic cross-section of the ocean along their routes. According to this programme, three professional oceanographers would be carried on each of the ships, and the ordinary time of crossing would be increased by about a week to enable the work to be thoroughly carried out. The Prince of Monaco has been asked to take part in the campaign.

The Effects of Smoke on Cattle were the subject of an inquiry addressed to farmers in the vicinity of Leeds, in connection with the investigations being carried out at Leeds University concerning the effects of atmospheric pollution on vegetation. It was learned that the effects of a smoky atmosphere on both cattle and horses are marked: young stock do not thrive, while older animals require more food and greater care than those living in a less contaminated atmosphere. The effects are partly due to the respiration of the smoke-laden air, and partly to the inferior quality of the grass growing under such conditions. The raising of sheep is even more difficult, because of the depreciation in value of the wool due to the smoke, and is rarely attempted near Leeds.

Freezing a Patient to Cure Him of Consumption.—Freezing of living persons is the somewhat heroic remedy proposed by the Russian scientist Bachmetieff, for the Koch bacillus is killed at 6 deg. Cent. below freezing point, it being the cause of tuberculosis, so that by congealing the person affected with the disease the microbes are all killed. Then he brings back the subject to life by a very gradual re-heating. He has already succeeded in applying his method to various animals such as the rat and others by producing artificial respiration in them at the same time that the freezing process is going on, and he thus produces suspension of life by cold which is of great interest to science and may also prove of much utility. Freezing of cattle in Winter would thus preserve them without food, and they could also be transported over great distances when in this state. Many other applications of the idea can be imagined. Of course, the method has not as yet been applied to the larger animals nor to living persons, but in principle this does not appear to be impossible, and it now remains to be proved whether a human being can be actually frozen and then brought back to life.

Aeronautics

The Trial of the Langley Aerodrome.—Our correspondent at *Hammondsport informs* us that the flights of the old Langley machine have thus far been brief hardly less than ten seconds. Hence they are not conclusive. Mr. Glenn H. Curtiss has about decided to substitute a more powerful engine—probably his eight-cylinder—and a single-tractor screw, since the present plant has not quite thrust enough for forty per cent extra weight due to floats and the trussing between them and the steel frame. The present arrangement has about twice the resistance of the original machine.

Pending Legislation for Army Aviation.—The passage by the House of Representatives of the Hay Bill looking to the establishment of a division relating to flying in the office of the Signal Corps encourages army officers because of what might be termed the official status thus given to aviation in the military establishment, especially as there is much hope for favorable action by the Senate on the bill.

American Hydro-Aeroplanes Abroad.—Philip Hoffman, the Secretary of Embassy at Constantinople, reports that the Ottoman Ministry of Marine has recently had under consideration the desirability of purchasing one or more hydro-aeroplanes or flying boats, one of which, under American auspices, has lately made several private trial flights near Constantinople with success, and it is reported that successful trials have also taken place in Russia.

Aeroplane Racing.—According to the ideas of Mr Paris Singer, one of the prominent Englishmen living in the Riviera, the time-honored horse race will be supplanted by the aeroplane race. Each proprietor will own a number of aeroplanes and have one or more pilots in his employ, and racing events will be held under the same conditions as for horse races, and no doubt with more excitement. To start the movement, which would be more of a success in the Riviera than elsewhere, owing to the favorable climate, he has now engaged the crack pilot, Maicon, and will purchase several fliers. Maicon will act as chief and will train other pilots if need be. Should others take up this idea, each proprietor will have his fleet, and there would be organized suitable racing events between them, or, on the other hand, the fliers will be sent to take part in various official contests. He expects to use watercraft largely for sailing upon the Mediterranean.

Germany's Air Strength.—It appears that Germany now has 14 large airships, including 7 Zeppelin destroyers. Their size is on the average 600,000 cubic feet, and they carry 600 to 800 horse-power motors. A crew of 15 to 20 men is carried, also 8 tons net load, comprising 1.5 tons of projectiles. As regards secondary questions, these are now very well organized. Between Berlin and the frontier are thirty balloon sheds and grounds with sheds of 600 feet length in many cases, pivoting upon large platforms so as to face the wind and allow the airships to enter safely. Balloon supplies are well looked after, and special railroad cars are fitted out with sets of steel hydrogen bottles mounted upon a common discharge pipe. Such cars are kept stationed in works which furnish hydrogen as a by-product, and are ready to be sent out upon the railroad wherever they are needed. The German army counts considerably upon night trips with the airship or aeroplane fleet, and all the needed measures have been taken to allow of doing this in good condition, the landing grounds being lighted at night and a system of colored electric flashes, as in lighthouses, shows special signals for each of the grounds. A powerful electric searchlight on board the airship also lights up the ground when landing.

The Third Russian Aeronautic Congress.—An interesting event was the third Russian Aeronautic Congress held at St. Petersburg. Numerous papers were read. In the military section we note the communications made by Lieut. Iatsouk upon rational training of army and navy pilots, and a paper by Gen. Kaulbars upon the necessity of different types of aeroplane. Col. Gatovsky presented a memoir on organization of the aerial fleet. The technical section had papers on the state of aviation at the present time, aerial propellers and the work of the Technological Institute aero-dynamic laboratory. Prof. Remne treated of wind pressures on various surfaces, and Prof. Sarkovsky of aero-dynamic comparisons among aeroplanes. In the section which concerns general and sporting questions, M. Chetamine read a paper on the situation of the aeronautic industry in Russia and other countries, and upon organizing of aerial militia. This last topic was taken up and completed by the Aero Club Secretary Weigueline in his paper on private aeroplanes in connection with military use. A leading paper of the congress was the report made by Engineer Berk upon use of railroads for organizing observations on the passage of aeroplanes and installing of landing places. It is thought that the present congress will be the starting point of a considerable development of aviation in Russia, especially as concerns military questions.

Photo by Topical Press Agency

Stepping the mast in "Shamrock."

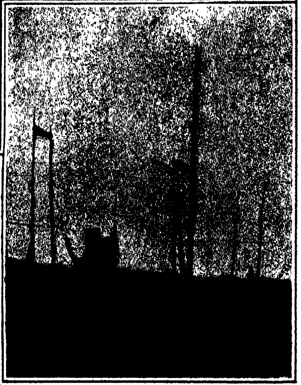


Photo. by Cribb, Southsea.

Note the lofty mast stepped far forward.

Photo by Topical Press Agency

Launch of "Shamrock IV." Nelson's "Victory" in distance.

The Launch of "Shamrock IV"

A Yacht Designed on Strictly Utilitarian Lines

OF great interest to American readers will be the photographic views which we publish of "Shamrock IV." The first impression one gains from the pictures is that designer Nicholson, realizing how closely contested are the present-day races for the "America's" Cup, determined to design his yacht along lines of the strictest utility. During the process of planning a purely racing yacht, such as "Shamrock IV," in which the question of ultimate speed is dependent upon the best possible combination of form, lightness, and strength, occasions will arise when beauty must be sacrificed to utility, or, to put it in another way, when the artist in the naval architect will demand one thing and the engineer in him will demand another. Evidently designer Nicholson decided that the only possible chance to win the 'America's' Cup was to build his yacht with exclusive regard for speed.

Photos by Cribb, Southsea.

Note the tumble-home, giving easy sailing lines when heeled.

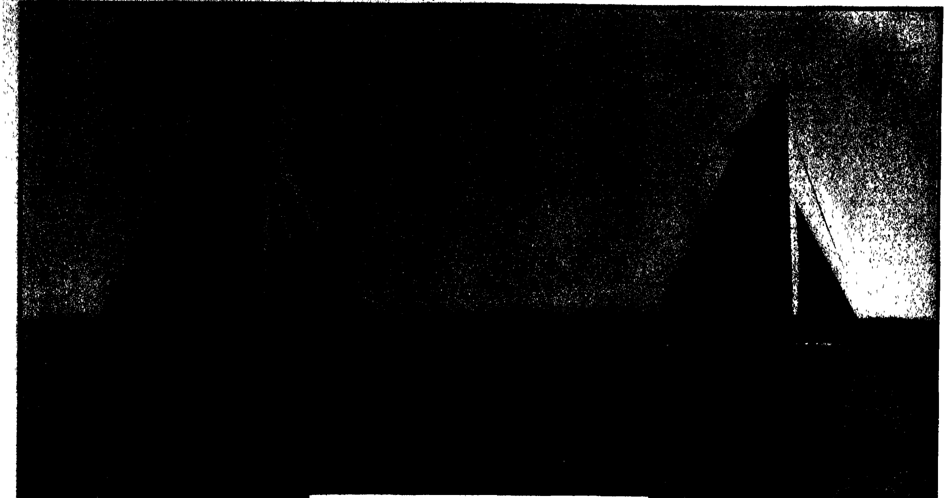
This line of thought reminds us of something that happened when we were watching the "Resolute" and "Vanitie" in their first trial race. A marine artist who was discussing the yachts said to the writer: "'Billy' Gardner is too much of an artist for his own good. 'Vanitie' is surely the sweetest thing that ever sat upon the water, but if Gardner had been willing to cut 5 feet off that beautiful tapering stern and another 5 feet off her long, keen bow, he would have saved sufficient weight on 'Vanitie' to gain several seconds of time in a 30-mile race." Nicholson has cut off the 10 feet of tapering grace and elegance; for his "Shamrock" is only 110 feet on deck, as compared with the 120 feet of the "Vanitie." Further evidence of weight-saving is seen in the considerable "tumble-home" of "Shamrock." She is broadest at the waterline, say about 23 feet, and cannot be more than about 20 feet in breadth at the deck. This means an additional saving in weight, because of the shorter deck beams and the reduced area of deck surface. True, this weight which is saved in the deck and put into the lead bulb is gained at some expense of beam; but as a compensation for this there is the fact that, when the yacht is heeled until her rail is awash, she is sailing upon easier lines.

Nicholson appears to have been willing to disregard the quarter-beam penalty, believing that the fuller waterlines, forward and aft, will give a sail-carrying capacity which will more than compensate for the penalties imposed. Judging from the photographs, the form of "Shamrock" appears to be a compromise between "Shamrock III" and "Reliance."

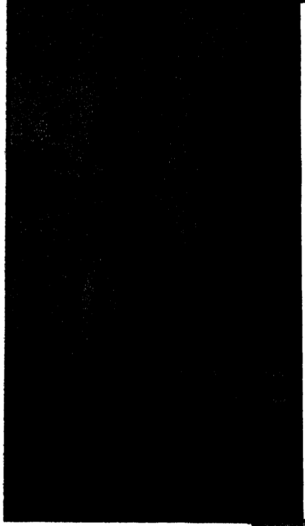
The construction of the yacht is very light, consisting of web framing, overlaid by a skin made up of three thicknesses of planking. The two skins next the framing are laid diagonally to give longitudinal stiffness, the outer layer being laid horizontally. The deck is exceedingly light, consisting of several layers of birch veneer, totaling less than an inch in thickness. A peculiarity in the outboard profile of the yacht, due to the persistent effort to save weight, is the fact that the sheer line drops somewhat, from amidships toward the bow—a change which will result in a not inconsiderable saving of weight in the forward portion of the hull.

The sail plan of "Shamrock IV" is similar to that of our own "Defiance." The mast is set far forward and the yacht carries a single head sail, the foot of which is laced to a boom, as in the case of "Resolute." The mast is so far forward,

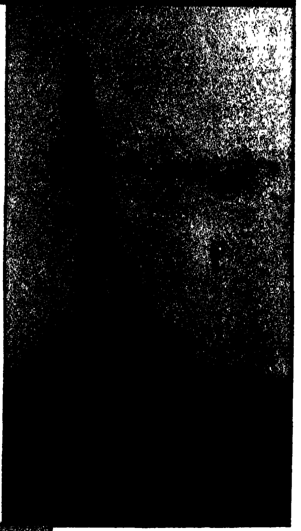
(Concluded on page 493.)



"Resolute" and "Vanitie" close-hauled on the port tack.



"Vanitie."



"Resolute."

Trial Races of the Cup Defenders

Promise of a Close Contest Between the Defending Yachts for First Position

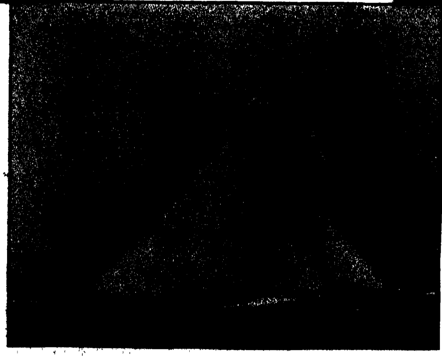
Photographs Copyright 1914 by Edwin Levick

WITH three yachts available for the defense of the "America's" Cup, the Cup Committee is going to make sure there is no mistake about the selection of the absolutely best of the three to meet the challenging vessel. No less than thirty-five contests will be held before a final choice is made. Of these, including those which have already taken place, twelve will be held in Long Island Sound, eleven will be sailed off Newport; three will be sailed on June 10th, 11th, and 12th off Sandy Hook; and during the New York Yacht Club's cruise in August, there will be a week of cup trials These races will provide an opportunity for the Cup Committee to observe the three defending yachts under all possible conditions of weather, from drifting matches to those sailed in a stiff blow

The first meeting of the yachts took place on June 2d over a triangular course off Great Captain Island, Long Island Sound. The "Defiance" was absent, for the reason that she was at City Island having a very considerable reduction made in her sail plan. In her preliminary tests the "Defiance" proved to be unable to carry her towering rig, heeling down under a breeze of moderate strength until her lee rail was far under water. Her mast is being shortened about nine feet, two feet are being taken off the main boom and something from the gaff, and it is hoped that with these changes the boat will be better in hand. We are not surprised that these defects developed. A reference to the plans which we published of the yachts on May 2d will show that the center of gravity of her lead is high relatively to the other two yachts. Furthermore, her keel is much shorter; in fact, in this respect she reminds one somewhat of "Independence," and, like "Independence," she has proved to be a difficult boat to hold on a true course. It is sincerely to be hoped that, after the changes are made, the "Defiance" will find herself, and that her owners will have the gratification of seeing her make a close fight for first honors with the other two yachts.

The first meeting between "Resolute" and "Vanitie," which was witnessed by the writer, verified the predictions which we made in our article published in the issue of May 2d. Whenever the course lay to windward and the sheets were flattened in, the Herreshoff boat pulled away from "Vanitie," particularly when the wind lightened. As soon as sheets were eased, the "Vanitie," with her long, easy sailing lines, proved to be the faster boat. On the first day the wind was very fluky, and to the skill of "Vanitie's" skipper in what is known as 'wind hunting' must be attributed a large part of the handsome margin of 16 minutes and 48 seconds by which "Vanitie" won the race From this must be deducted 3¼ minutes, the time that the "Vanitie" had to allow to the smaller boat

In the second race, sailed June 3d, there was a good sailing breeze throughout the race, and neither boat was particularly favored Here again the "Resolute" showed her superiority in windward work, and "Vanitie" proved the faster on a reach The boats finished with only 11 seconds difference between them. "Resolute" got away 12 seconds ahead of "Vanitie" and finished 11 seconds ahead, which with her time allowance of 3¼ minutes gave her an advantage of about 3 minutes and 26 seconds over the Gardner boat The superior work of "Resolute" to windward was shown by the time at the first mark, which "Resolute" turned at 1:9 57 and "Vanitie" at 1:11:59, or 2 minutes



"Vanitie" with her lee rail awash.

and 2 seconds later. In the broad reach home, "Vanitie" showed her reaching ability by cutting down the lead of "Resolute" to 54 seconds only. Going to windward over the 7½ miles on the second round, the yachts were practically even, and in the last homestretch of reaching "Vanitie" gained 31 seconds on "Resolute."

In comparing the two yachts it must be borne in mind that "Resolute" had had about one month of tuning up. Her sails were well stretched and their set was perfection. "Vanitie," on the other hand, had been out for only two or three short sail-stretching spins, and it was evident that her sails were in no such condition as those of "Resolute." As the various races take place, each will steadily improve, particularly in windward work. At the present writing, it looks as though "Vanitie" might be able, when she has thoroughly found herself, to save the 3¼-minute time allowance, with sufficient in hand to make her a winner by a slight margin. In any case, the races between these two yachts promise to be the most close and interesting that have ever occurred in the history of "America's" Cup defense.

An interesting feature in "Vanitie" is the fact that she is a model-basin yacht, several thousands of dollars having been spent in testing various models in the naval towing tank at Washington before the present form was decided upon. In this connection it is of interest to remember that by far the most successful yacht sent over from the other side, the "Shamrock II," was also a model tank yacht, Watson, her designer, having spent some nine months in experimental work in the model basin at the Denny yard, Scotland, in developing her form.

The New Wright Flexible Drive

THE new Wright flexible drive as adopted on the new aeroboats and military machines consists of an auxiliary shaft connected at one end to the motor by the shock-absorbing element and at the other end driving the propellers. On the flywheel of the engine there are fixed steel pins, and at the end of the auxiliary drive shaft there is a steel cone with similar pins attached to it. The pins on the flywheel are attached to the pins on the drive shaft cone by a number of shock absorbers. The transmission end of the shaft is supported by a bearing, while the other end of the auxiliary shaft merely rests on the crankshaft of the motor, free to rotate about it, but restrained and held in position by the shock absorbers. There is thus obtained a perfectly flexible unit, the power being transmitted through the shock absorbers. There are eight shock absorbers used in the drive for the six-cylinder Wright engine. Any variations or shocks in the rotation of the motor are taken up by the stretch of these shock absorbers. In a back fire, for example, the motor will stretch the shock absorbers almost a half revolution before effecting the transmission. The amount of spring that can be obtained by this device is very great. It takes up, without damage to the transmission or to the rest of the machine, the most severe vibrations of the engine, at the same time greatly easing up the strains on the engine itself. The additional weight of the drive on the new Wright aeroboat is only about 18 pounds.

In addition to reducing the shocks on the entire machine and greatly eliminating dangers of crystallization of steel parts, the introduction of the flexible drive permits of entire freedom in design with reference to the placing of the engines and propellers. In the case of the Wright aeroboat and the new Wright military machines, it has rendered exceedingly simple and practical the installation of the engine in front of the operators, motor-car fashion, with the propellers in the rear.

This combines the elements of safety due to placing the motor in front, the comfort and efficiency of the propellers at the rear, and (though the seats are back of the engine and slightly back of the edge of the planes) the view for observation is not in any way seriously restricted. The extreme comfort of flying in a machine of this type has been a revelation to those who have had the opportunity of taking trips on these new machines. There is a feeling of security in seeing the motor in front of one, and it is interesting to note that the noise does not seem to be as great as having the motor at one's back, or over one's head.

Important Regulation as to Guaranties Under the Pure Food Law

THE Secretary of the Treasury, of Agriculture, and of Commerce, acting under the authority vested in them by the Food and Drugs Act, looking to the joint making of regulations, on May 5th, 1914, directed that after May 1st, 1915, the regulation No. 9 of the Rules and Regulations under the Food and Drugs Act should be amended in several respects, particularly to the effect that hereafter, that is to say, after May 1st, 1915 no guaranty in any form shall be filed with and no serial number shall hereafter be given to any guaranty by the Secretary of Agriculture, and that all guaranties now on file with the Secretary of Agriculture shall be stricken from the files, and the serial numbers assigned to such guaranties shall be canceled, and that the use on the label or package of any food or drug of any serial number required to be canceled as above is prohibited. This regulation when once effective will materially change the manner of marking merchantable matter coming under the Food and Drugs Act.

The Fallacy of the Double Dirigible Balloon

By R. H. Upson

DOUBLE or multiple balloons have always been an attractive field for experiment, and it is unfortunate for this reason that they have so little practical value. Several balloons of this type have been built, notably that of M. Rose which attracted considerable attention a few years ago, but as far as I can discover, it never made any respectable flights. For all that, there is nothing impossible about such a balloon, but it would be comparatively inefficient, and there seems no more real occasion for one just now than a double boat or catamaran. The latter is sometimes made for a very special reason; so might a double balloon, but it would have to be a very good reason to overcome its many objectionable features.

The principal objections all depend on the following proposition.

If the volume of a single solid be divided up among two or more similar solids there will be more surface in proportion to the volume than before.

When applied to a dirigible balloon, this means that a double balloon of the same volume and gross lift will have more surface, more resistance, more leakage, less speed, will be more easily affected by temperature, will be harder and more expensive to make, and in ordinary cases will be heavier owing to the increased width of the car.

As a numerical example, let us see how much we can improve a medium sized dirigible of 375,000 cubic feet capacity and 200 horse-power by dividing it into two balloons, side by side, of the same length and gross volume. (The balloon is purposely assumed of comparatively low speed to give all the advantage possible to the proposed double construction.)

The longitudinal surface will be multiplied by 2. The weight of the gas bag will remain practically the same, but the weight of the car will be nearly doubled. Assuming the same horse-power and propeller efficiency, we get the following table of comparison:

	Original Dirigible	Double Balloon
Head Area	1,900 square feet	1,900 square feet
Longitudinal Area	34,000 square feet	46,700 square feet
Resistance of Gas Bags at 30 miles per hour	1,050 pounds	1,210 pounds
Resistance of Car at 30 miles per hour	250 pounds	400 pounds
Speed	30 miles per hour	28 miles per hour
Weight of Bag	4,600 pounds	4,600 pounds
Weight of Car	5,900 pounds	10,000 pounds
Surplus Lift	12,300 pounds	8,200 pounds

It can be seen that we have hurt the balloon in nearly every possible way and have gained practically nothing.

We could have a little more propeller area, but we need more with an increased resistance to keep the same efficiency. There would be more room to attach aeroplane surfaces, but we could attach all we would want to use to the original car without sacrificing so much.

It could turn in a little sharper circle, but that is hardly an advantage, especially as it could be effected, if desired, by merely increasing the rudder surface.

One of the objects of making a balloon in this form is frequently to give proper support to a very large aeroplane surface covering the whole bottom of the balloon. Going back to our assumed double balloon, a surface could easily be attached to the bottom which would be 200 feet long by 40 feet wide, or 8,000 square feet. As a Wright aeroplane of 400 square feet lifts about 700 pounds at the same speed, one might think that this surface would give a lift of 14,000 pounds, but such is far from the case. There are several things which very much lower its efficiency. It is flat, it is long in the direction of motion, and the big balloons interfere with the free flow of air around it. Neglecting the last consideration, the reaction on such a surface is expressed fairly well by Newton's old formula which, for an angle of 10 degrees, gives a lift of 680 pounds, or actually less than the small but properly proportioned aeroplane, at about the same angle.

It might be said that this formula assumes an infinitely long plane, but all things considered, the result is probably not far from correct. If we take 800 pounds as a fair estimate, we get 0.1 pound per square foot of surface, not even enough to lift its own weight. This almost inconceivable difference is not only a theoretical deduction, but it has plenty of experimental proof.

The following argument is sometimes used for a flat or multiple balloon: "An aeroplane has a very small resistance in a direction perpendicular to its course; hence it is not very easily blown out of its course by a side wind; but the ordinary dirigible is at the mercy of the winds on account of its large side area. This side resistance could be very much cut down by multiplying the balloons laterally."

A little thought will at once show that this argument is entirely fallacious. I won't try to prove it here except by saying that if such an argument could be proven sound, then perpetual motion is a *realized fact*. Here is the proposition, and I can't state it too strongly.

Given a wind of uniform velocity and direction, and an airship of any kind suspended in and by the air and using the air for propulsion. Then no matter how hard the wind blows or what the form of the airship is, it can go *through the air* (not over the ground) in no other direction and at no other speed than that determined by its own power. That is, in a given wind of uniform velocity the question of dirigibility is merely one of speed, *and absolutely nothing else.*

The numerous gusts and eddies in an actual wind affect the stability of an aeroplane very seriously but do not materially affect its direction of motion. With a dirigible, the effect of gusts may be totally disregarded for most purposes, and the problem of resultant speed becomes merely one of relative motion like a boat in a moving stream. To a person in free flight there can be no wind from the side except in the nature of sudden gusts.

A low side resistance might seem to be of considerable value when using a drag rope, water brake, etc., and more especially to lower the wind pressure when moored to the ground; but here again the result is out of all proportion to the cost of attaining it.

We now come to a possible use for the double balloon which does not apply to present sizes, but which is nevertheless real, and would be well worth investigating for extremely large sizes.

Consider the fabric above the suspension as made up of two parts or layers, one to resist internal compression, and the balance to carry the weight. Call these *A* and *B*. For equal strength and speed, the weight of *A* per square foot will vary just a little more than as the diameter of the balloon, so that for similar balloons the total weight of *A* is nearly proportional to the total volume or lift. The case of *B* is different. It has to sustain a weight, per foot of length, which is very nearly proportional to the area of the section or to the square of the diameter. Hence its weight per square foot will vary as the square of the linear dimensions and its total weight as the fourth power of the dimensions (for similar balloons). As the lift only increases as the cube, a point will evidently be reached when the weight of the gas bag will be excessive compared to the lift. It then becomes necessary to change the design so as to shorten the length of the fabric passing over the balloon.

This could be easily done by making the balloon double. But it would not be of advantage until the balloon was well over 1,000 feet long; and even then, it is probable that a better solution would be found in the rigid type as developed by Count Zeppelin.

Inventor of the Tabulator Typewriter

SOME time ago it was stated in the SCIENTIFIC AMERICAN that H. S. McCormack was the inventor of the tabulator typewriter. We are indebted to the Underwood Typewriter Company for copies of the decisions of both the lower and higher United States courts in the State of New York, in which decision it is held that Josiah B. Guthright was the first inventor of the typewriter tabulator.

The Death of Dr. Von Mauser

DR. PAUL VON MAUSER, inventor of the well-known rifle that bears his name, died in Berlin on May 29th at the age of 76. He began life as an humble gunsmith. He is said to have been financed by an American named Norris. His rifle was later adopted by the German army and several European armies.

The Current Supplement

IN this week's issue, No. 2006, of the SUPPLEMENT, Dr. E. F. Roeber's presidential address before the American Electrochemical Society is published. Its subject is "Some Economic and Æsthetic Aspects of Electrochemistry."—Prof. Kollmann shows how facial features are reconstructed with scientific accuracy from a human skull.—H. O. Swoboda writes on electric safety lamps for miners.—Dr. Glasebrook's paper on the development of the aeroplane is concluded in this issue.—E. Marriage, in an article illustrated with microphotographs, writes on the difficulties of detecting adulterations in fruit preserves.—Frank C. Perkins describes several types of electric cold saws.—Dr. Eccles's article on recent patents in radiotelegraphy and radiotelephony is concluded in this issue.

The Life Story of an Atom

By John W. N. Sullivan

THERE has always been something paradoxical about the notion of an atom. When we are told that matter is built up of a number of tiny little particles, which are themselves incapable of division, we grow perplexed. However small the ultimate particles of matter may be, they must have a certain size; and that being so, it is not at all clear why they cannot themselves be subdivided to an indefinite extent. As a philosophic theory, the atomic idea is most unsatisfactory. It is only when it is considered merely as a useful working hypothesis in scientific investigation that it has any value. Atoms are indivisible in the sense that an atom of any element is the smallest part of that element which takes part in any chemical reaction. Provided that we regard an atom in this light, it is a perfectly legitimate conception.

Lucretius, the old Latin poet, held an atomic theory of the universe, a theory which he enshrined in immortal verse. And although, philosophically considered, an atomic theory plunges us into difficulties, yet our imagination is equally baffled if we try to do without it. If we try to regard matter as perfectly continuous, i. e., as capable of infinite subdivision, we shall find it quite impossible. This dilemma has led to all sorts of queer theories, but we shall see that the modern scientific theory of matter is a peculiar compound of both views.

The modern theory is the outcome of the startling discovery that the atom is by no means indivisible, even in practice. It has been shown experimentally that the old chemical atom is built up of a number of much smaller particles, and we shall see that there is good reason to believe that these very small particles are really indivisible, in the sense that if they were divided they would also be annihilated in the process. These very small particles are called electrons, and they were first discovered in the course of experiments made on the electric discharge in vacuum tubes. It is well known that if we try to make a current pass between two conductors which are separated by an air space we have to use a very high potential and the current passes in the form of a spark. If, however, we put our two conductors in a tube from which the air has been almost completely exhausted, we get some very extraordinary results. Close to one of the conductors we get a blue glow, succeeded by a dark space, which in turn is succeeded by another luminous region. But besides these appearances, and crossing over them as though regardless of their presence, is a shaft of bluish light, which proceeds in straight lines from the surface of the conductor. If the conductor has a concave shape this shaft of light may be concentrated to a focus; and if a piece of platinum be placed at the focus it will be rendered incandescent. When the stream strikes the walls of the vessel or a solid obstacle within it, we get a phosphorescent glow, the color of which depends upon the material composing the vessel or obstacle. Clearly defined shadows are cast on the wall of the tube by any solid object which is interposed in the path of the stream. This stream or shaft of light may be deflected by magnets or electrified bodies brought into its neighborhood, and from the way in which these deflections occur, we are led to infer that the stream consists of a number of very small particles charged with negative electricity, moving at the rate of several thousands of miles a second. When these particles are abruptly stopped by collision with the walls of the containing vessel, they throw the surrounding ether into a state of disturbance, which manifests itself as rays of very short wave length—the famous X-rays with which everybody is now familiar, and which have such numerous applications in surgery and medical science.

The members of this stream of negatively electrified particles are identical in their properties, and they are called negative electrons. The mass of a negative electron has been found to be about 1/1700 of that of the lightest of all known atoms—the hydrogen atom. The conductor from which these negative electrons are shot off is called the negative electrode. If we perforate it streamers appear behind it, which consist of positively electrified particles, which are much larger than the members of the negative stream and also move at much slower velocities. Not only do the negative electrons set up disturbances in the ether when they are stopped by collision, but also when any change occurs in their velocities. If we merely change the direction in which an electron is moving, without altering the speed at which it moves, ether disturbances are set up, and energy is radiated away from the electron into external space. So that an electron rotating at a uniform speed in a circle is continually radiating energy, since its velocity is continually changing in direction. We shall see that this fact has an intimate bearing on the phenomena of radio-activity.

The most interesting feature about these negative electrons, and one which has transformed all our ordinary notions of matter, comes to light when we investigate the relation between the mass of an electron and its electric charge. It was shown by Sir J. J. Thomson that when a body is charged with electricity, its apparent mass is increased. This increase in mass depends not only on the magnitude of the electric charge, but also on the velocity with which the body is moving. Now the electric charge on an electron has been measured, and likewise its velocity, so that we are in a position to calculate what part of its apparent mass depends on its electric charge. When this extra mass is compared with the actual mass of an electron measured experimentally, we find that the two results are equal: in other words, the *whole* mass of an electron is due to its electric charge.

This result changes our whole concept of matter, for all matter is regarded as built up of electrons, and the mass of an electron is purely electromagnetic. The electron itself then, is not matter as we know it. We may gain some idea of the modern idea of the constitution of matter, by considering the smoke rings that some tobacco smokers are able to produce. A smoke ring is produced by setting part of the air in a particular kind of motion, a motion at once of rotation and translation, which then travels through the air as if it were a separate object. In the case of a smoke ring the little particles of smoke caught up in the air travel with it and enable us to trace its progress. We have set up a local modification of the air, which then takes on a more or less permanent existence and travels through the air as if it were some solid body. If the air were continuous and frictionless, the smoke ring would last forever, and could, in conjunction with other smoke rings, build up systems which would manifest the properties of material bodies.

Now a continuous and frictionless medium does exist, to wit, the ether. The ether permeates all space and is the universal carrier of energy, whether in the form of X-rays, light rays, heat rays, or rays of electricity. An electron, then, is regarded as some modification of part of this universal medium; it is entirely composed of ether, and is yet different from the ether, much as a smoke ring is composed of air and yet travels through it as an independent body. So that the old philosophic puzzle as to the atomic constitution or continuity of matter here receives an answer which embraces both solutions. Matter is continuous, since it is one with the ether; and matter is atomic, since it is built up of small particles which are separate from one another.

The atoms of matter are built up out of electrons much as our solar system is built up out of planets. In each case there is a central body: in the case of the solar system it is the sun and in the case of the atom it is a change of positive electricity. Circulating round this central change are a number of negative electrons, the whole system constituting an atom of matter. By a consideration of the different systems which can be built up in this way we can account for many of the properties manifested by the chemical elements. But in regarding the atom as built up in this way there is one fact which must strike us as of unusual significance. On this theory, *matter is not stable*. We have already pointed out that rotating electrons radiate energy, and here we consider an atom as built up of a system of rotating electrons. So that an atom is not a stable affair. Energy cannot be radiated indefinitely without a fundamental transformation of some kind occurring. We should expect the atom to break up eventually into some simpler form.

The phenomena of radio-activity show us that this is precisely what does occur. In an atom of radium we have a system which is in process of disintegration. The radium atom is breaking up and ceasing to exist as radium. Elements of less atomic weight, the results of its destruction, form in its place. But they also, although more stable, are not permanently stable. They, too, must break up and disappear, to give place to still simpler elements. This process cannot cease till the atom is resolved into its constituent electrons, but side by side with this disintegration of matter we have a synthesis, of which we have the clearest evidence in the stars. The older and cooler stars contain more complicated chemical elements than the hotter and younger stars, and the conclusion is irresistible that we are in the presence of a gigantic evolution of matter from its primitive source in the universal ether Side by side with death we have birth, and the universe moves through ceaseless cycles from decay to a fresh renewing.

The Largest Insects in the World are described by O. W. Barrett in the *Philippine Agricultural Review*. The largest known winged orthopter is a species of phasmid, or walking-stick (*Palophus Titan* Sjöstedt) recently discovered in Nyassaland. Its body is 10 1/3 inches long. Borneo boasts a wingless phasmid (*Phobecticus Kirbyi* Redt.) 13 inches long. This is the largest living insect, but was surpassed by a dragon-fly-like insect (*Meganeura Monyi* Brongn.), with wing expanse of 25 inches and a body 14 inches long, which flourished in France in the Carboniferous period.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Foucault Experiment

To the Editor of the SCIENTIFIC AMERICAN:

In the issue of February 14th, 1914, of your valued paper, you publish an interesting article, "Watching the World Revolve," of Foucault's celebrated demonstration in the Pantheon, in Paris, in 1851.

This experiment was repeated for the second time in the Spring of 1857, in the choir of the cathedral of Lausanne, by Prof Louis Dufour, of the academy of that city.

As a young student I was witness of said experiment, which was then repeated several times before a large number of visitors.

EDOUARD SILLIG,
Former Headmaster of Sillig's School.
Bellerive, Vevey, Switzerland

The E. J. C. Motor

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of May 2nd I was very pleased to see an article regarding my aviation motor, for which I wish to thank you.

I would, however, like you to correct a very important mistake which your correspondent has made in describing my motor, and which entirely destroys all the advantages that I claim for it. Your correspondent describes the motor as having a differential to regulate the speed of the two propellers. We claim just the opposite, that is to say, that we have no gears at all in the motor itself. There already exists a motor on the principle described by your correspondent, and it may mislead the interested parties the error published in your article. If my motor had a differential to regulate the speed of the propellers, it would not only not be any better than all the other aviation motors, but it would be much worse. My claim is that my motor will outlast all the existing motors of to-day, as it rotates absolutely free on its axle, which is mounted on ball bearings.

My motor is now running perfectly and flying every day at Chateaufort. We are waiting the delivery of a Caudron biplane, made under special design to hold enough gasoline for a twenty-four hour flight, with which we expect to prove that our motor is the best existing to-day.

E. J. CONILL.
Paris, France.

The Coast and Geodetic Survey Tide-predicting Machine

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of May 30th, 1914, Mr. Fischer attempts to befog the public mind in reference to the facts contained in my note (appearing in your issue for May 2nd) by making the following statement

"The officials of that bureau are thoroughly familiar with its development from its first inception, prior to 1890 (the year in which Dr. Harris entered the service), to its final completion."

If Mr. Fischer can furnish any reliable evidence that the general scheme which characterizes the new machine and distinguishes it from other machines existed in any sense prior to my conception of it in the early nineties, he will have rendered a service to those who may be interested in the historical development of these appliances. I have no knowledge that such plan or scheme had been conceived at some earlier date, either here or elsewhere; nor have I any reason for believing that, subsequent to the construction of the Ferrel machine in the early eighties and prior to the time when the general plan of the new machine first occurred to me, the Survey had ever considered or recommended the construction or purchase of any tide-predicting machine other than some machine of the Thomson type.

Mr. Fischer's *Engineering News* article, and to which he refers, was apparently written largely in the attempt to minimize or ignore my claim as the originator of the machine. Moreover, the article contains statements which cannot be successfully defended.

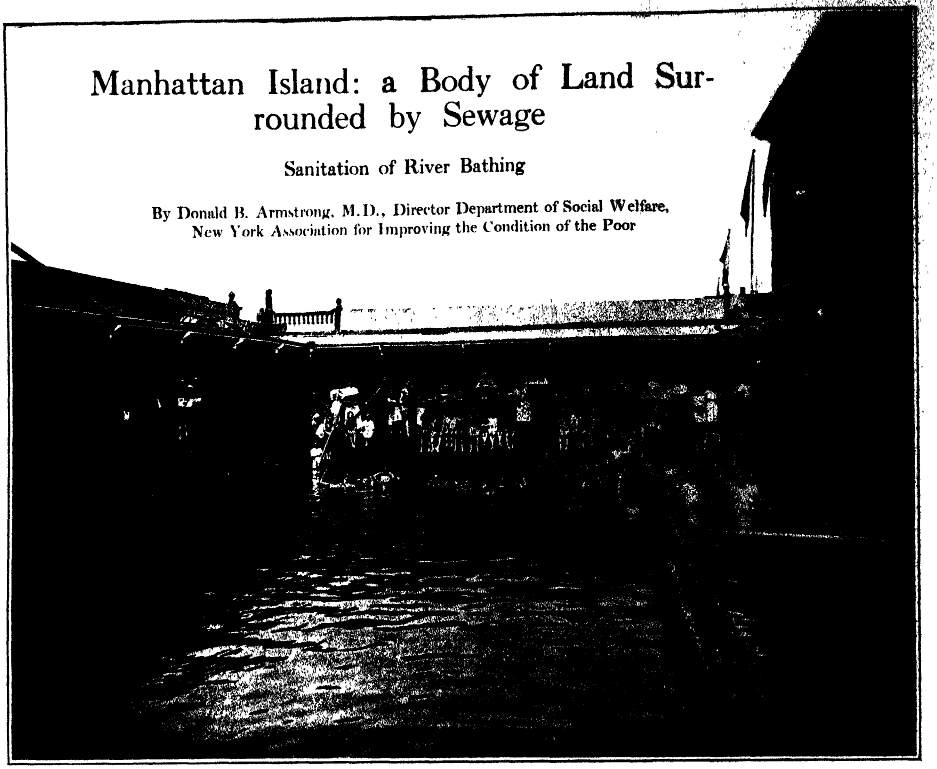
Washington, D. C. R. A. HARRIS.

The 72-inch Reflecting Telescope now under construction for the Canadian government, a description of which was recently published in these columns, is to be located on Little Saanich Mountain, near Victoria, B. C. This site was chosen after prolonged investigation of atmospheric conditions in different parts of the Dominion, and despite the fact that its selection entails much additional expense for the purchase of land, the construction of a road, and other preliminaries, as compared with other sites that were under consideration.

Manhattan Island: a Body of Land Surrounded by Sewage

Sanitation of River Bathing

By Donald B. Armstrong, M.D., Director Department of Social Welfare,
New York Association for Improving the Condition of the Poor



A typical floating bath. Coarse screens keep out the solid portion of the sewage, but the water is none the less contaminated, and, therefore, a menace to health.

THE majority of people have reached the point where they prefer their milk undiluted with typhoid-contaminated human excrement. This is, of course, partly a matter of decency, but largely a matter of health. Somewhat in contrast to this, it is found that most cities make large expenditures for street sprinkling, so that the food to be eaten may not be covered with a dusting of granulated horse manure. This is placed in contrast to the first proposition because, while there is an appreciable health factor, the chief justification of our effort in this field is based on decency. Most of our health or pseudo-health activities are founded on decency or health, or both. Rarely a problem is met where the two motive forces are not almost equally intermingled. Such would seem to be the case in the question of bathing in semi-sewage. It has been said that "Manhattan Island is a body of land surrounded by sewage." This is scarcely an exaggeration, for the waters adjacent to Manhattan, affected as they are by tidal currents, preventing a continuous and free flowage, receive about 499,000,000 gallons of sewage per day. This excrementitious material is inevitably infected and must remain, for a time at least, infectious. At certain times there is not a slip in the North or East River in which it is impossible to see human excrement. It was found necessary in the municipal floating baths, constructed with slats separated so as to permit the free entrance and exit of river water into the bathing tank, to nail additional slats over the openings, narrowing the spaces, so that the larger and, consequently, more objectionable particles of sewage did not enter. At the open beaches in the North River it is necessary to screen the river water as it flows down from the adjacent sewer by the bathing establishment so as to remove the unesthetic sludge. Screening, while admittedly necessary in this situation, is not considered a final method of treatment in sewage disposal, and obviously would be particularly objectionable as such if we are using the sewage for drinking purposes, and that is practically the situation when it is used for bathing. It is impossible to maintain a bath on the shores of Manhattan Island not adjacent to a sewer exit, for there are 140 sewers emptying into the rivers from that borough alone. Hundreds of thousands of people use this medium for cleansing and recreation purposes every Summer. It is equally dangerous and indecent. Its sanitation or elimination is essential for establishing public decency and for insuring public health in New York city.

At the present time there are three main types of bathing in New York harbor.

1. Unregulated Bathing.

This promiscuous and surreptitious bathing is from the piers and bulkheads at the foot of many of the streets. This is forbidden, though the enforcement of the regulation is practically impossible without a more thorough policing of the waterfront.

2. Beach Bathing.

There are several open beaches in New York Harbor, north of the Narrows and south of Spuyten Duyvil and the Bronx Kills, notably those adjacent to Washington Heights on the upper North River. Nothing is done, and of course nothing can be done at these places short of a radical change in our method of sewage disposal, to sanitate the water used in these baths.

3. The Floating Baths.

These are both public and private, and are situated in the North River and the East River and at the Battery, in the Boroughs of Manhattan and Kings. The baths of this type maintained by the city alone were used by 1,818,721 bathers in the year 1911. Yearly in New York there are about 550 deaths from typhoid fever, which means an incidence from this disease of about 5,000 cases. How much of this infection is a result of the short-circuit of contaminated excrement from individual to individual through river bathing it is impossible to say. It would seem safe and reasonable to assume, however, that the factor was not a negligible one.

What are we to do with these various forms of bathing? All authorities are agreed that the water should not be used unless in some way treated and rendered both safe and decent. Those who have reached this conclusion are agreed, also, that unregulated promiscuous bathing, as well as unprotected beach bathing, must be discontinued, for at the present time it is impossible to treat the water properly in these instances. What can be done with the floating baths? The results of bacteriological studies carried on by the Bureau of Public Health and Hygiene of the New York Association for Improving the Condition of the Poor indicate that radical treatment is necessary.

The counts practically represented the condition of the river water as well as of the water in the baths. The inconsistency of permitting bathing in this highly-polluted water without any attempt at purification and at the same time insisting on filtration and disinfection of Croton water for indoor pools is obvious. At the present time Croton water rarely contains over 100 bacteria per cubic centimeter, and with great consistency Colon bacilli are *not* found in 10 cubic centimeters. This water is filtered and disinfected when it is used in indoor pools. In contrast to this, the floating baths have encouraged bathing in semi-sewage where the bacteria are frequently as high as 3,000,000 per cubic centimeter, and where Colon bacilli, undoubtedly of human fæcal origin in this location, are found frequently in quantities as small as 1/1000 cubic centimeter.

With the floating bath it is possible to do one of three things, and these possible solutions will be discussed under the following headings:

1. Discontinuance.

This would seem to be the most logical and economic method. Floating baths as originally constructed cost the city $12,000 or $15,000 apiece. They were simply floating basins, having on them dressing-rooms and toilet facilities. They do, undoubtedly, take advantage of the tendency of the boy to go in swimming in the Summer time. At the same time, when, as under present conditions, he is compelled to satisfy that desire by swimming in sewage, one concludes that a redirection of the same tendency is worth the expenditure of a great deal of energy and money. The floating baths are open on an average of about three months a year, while an indoor bath may be kept open, and ordinarily is, the year round. The increased effective-

[illegible] of the indoor bath, because of the fact that it is open the year round, is a factor worthy of serious consideration. It would require $30,000 as the initial cost of providing a single model floating bath with filtration and disinfection, the operating expenses of which would undoubtedly be greater than those from which the above figures were taken, and the efficient and safe handling of which would be exceedingly doubtful under the best of circumstances. It may be said that for three times that amount a reasonably large indoor bath, equipped with showers and a pool, could be constructed. The West Sixtieth Street bath, containing 69 showers, 1 tub, and 1 pool, cost $126,550 in 1906. If the plan were, as has been previously advocated, to have smaller baths, with fewer units, at more frequent intervals, and if it were planned to have, eventually, these small baths at reasonably frequent intervals in the congested population centers near the water's edge, it might be reasonably supposed that the ideal bath for these purposes would be smaller than the West Sixtieth Street plant. It is probable that an equipment of 40 showers and a smaller pool would cost approximately $90,000. If the floating baths were entirely discontinued, and were replaced by small indoor baths at frequent intervals, there would undoubtedly have to be, for a time at least, some policing of the waterfront, to prevent the boys from going in bathing off the wharves. Positive measures of public bath advertising would help to accomplish this.

2. Reconstruction for Use of River Water.

In some experiments carried on last Summer in co-operation with the Department of Public Works, the Department of Social Welfare of the Association for Improving the Condition of the Poor had a tentative plan drawn up for an equipment that would meet this need to be attached to one of the present municipal floats. This was so devised as to permit the use of either fresh water from a street main or salt water from the river, disinfected with hypochlorite of lime and filtered. The present municipal floats were constructed in 1880 and have seen a good deal of wear and tear, so it is doubtful if they would stand much more service when subjected to remodeling with additional equipment. This is particularly true in view of the fact that additional equipment would have to include pumping apparatus. Here also enters in another objectionable item of expense, especially when it is to be of use for only three months of the year. It would seem that permanent all-year-round indoor pools were decidedly more advantageous and promising than river bathing under these conditions. It may be logical and desirable to turn to the river for our baths when we have found a way of discontinuing contamination of the river as a whole. The success of purifying the water piecemeal, so to speak, is extremely doubtful.

3. Reconstruction for Use of Fresh Water.

In co-operation with the municipal authorities, a tank of this kind was actually completed and put in use in September of last year. Croton water was used from a street main and was run into a float at the foot of East Fifth Street, being distributed by a number of inlet pipes placed at the bottom of the pool. The water was disinfected with hypochlorite and was run into the pool without filtration or refiltration in sufficiently large quantities to change the water in the pool at least once every day. With this plan there was no pumping expense, though there was a large waste of Croton water. The experiment was not a great success for several reasons, the chief one of which was the non-water-tight construction. Safety and decency can undoubtedly be secured by this method with a greater outlay, though the plant is useful for only a small part of the year, and it would seem that the money which must be spent on the additional equipment and reconstruction might be more effectively employed in increasing the capacity and the use of the all-year-round baths Recently the Board of Health of the city of New York approved a set of regulations regarding bathing in pools in or adjacent to New York city. These rules require water-tight construction, sanitary toilet facilities, shower facilities, etc. In view of the additional equipment which these requirements imply, it would seem that the first method discussed, that is, discontinuance, were the one to be advocated. With this should go, of course, positive constructive measures regarding the indoor pools. It is probable that very few private-bath owners can afford to make the changes necessary. Is it a rational municipal expenditure?

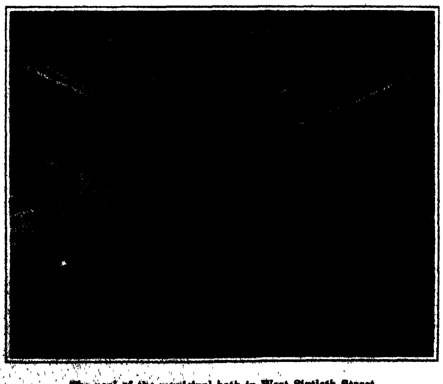
Four samples of Hudson River water from widely separated points.

Sewer discharging into Hudson River.

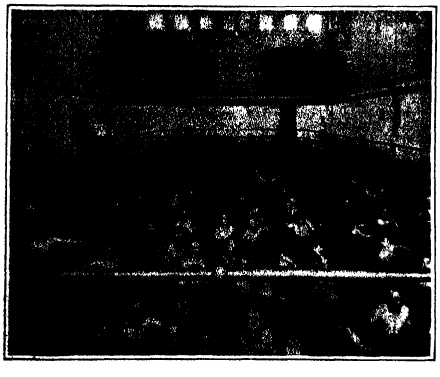
The chief justification for this municipal activity, in any event, is its educational value. At the present time the city has an excellent nucleus of cleanliness and health-promoting indoor pools. Those already in use are to be found at Rutgers Place, East Twenty third Street, and West Sixtieth Street. A new one is to be opened immediately at the Rivington Street bath, while three more pools, two at East Fifty fourth Street and one at West Twenty eighth Street, are under construction. Still another is planned at Carmine Street, and it is hoped that the municipality will see the necessity for the construction of a pool on the upper East Side, possibly in connection with the bath on East 109th Street. Besides these plunges the city has, at the present time, distributed in twelve public baths, 1,297 shower units and 80 tub units, the use of which, together with the pools, is entirely free. These indoor baths encourage cleanliness all the year round, while the river baths practically afford a series of swims during the Summer time. The floating bath is not nearly so apt to form a bath habit, for it must be discontinued in the Fall. The returns, in cleanliness and health, from an investment in indoor-all-year-round baths promises to be many times what might be the expected returns from the floating baths.

The Gordon Bennett Race

THE French Aero Club had some difficulty in deciding where this year's Gordon Bennett aeroplane event was to take place. On one hand, the municipality of Vichy proposed to organize the affair and to lay out the grounds, and on the other hand, M. Blériot offered the Buc grounds for the event. Opinion lay in favor of holding the event at Buc, for this year's rules require a circuit of 3 miles' length and 300 feet width, upon which an automobile can run at slow speed. Such a track costs much to lay out, but it can be done more easily on the Buc grounds, for these are already in good condition. Pilots, of course, prefer the track which lies near Paris and is among the aviation centers, and as regards the attendance of the public, the latter place is a much better one. Accordingly, after some discussion, it was decided to hold the cup event at the Buc grounds, and it will take place in September. It seems undecided as yet whether or not the United States will participate.

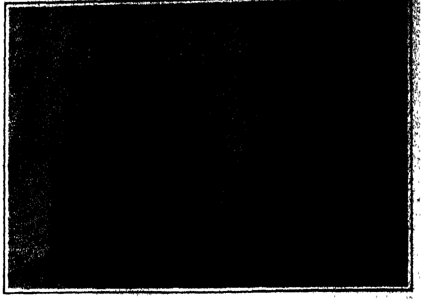


The pool of the municipal bath in West Sixtieth Street, New York.



An active hour at the East Twenty-third Street pool in New York.

The planetary gear pump throwing a powerful stream.



The odd gearing of the fire pump.

Variable Speed Transmission and Rotary Pump

A Hydraulic Motor Using Planetary Gears for Piston

FOR many years, particularly since the advent of the automobile, many efforts have been made to devise a simple variable speed transmission gearing. Such gearing is needed in an automobile to transmit power to the differential without the use of change gears, in battleships to elevate the guns and train the turrets; in machine tools to provide different speeds without shifting belts and gears As yet no strictly mechanical transmission gearing of this type has been commercially developed, but there are several hydraulic systems in use

Herewith we illustrate a new transmission gear of the hydraulic type, which, however, differs materially from previous gears and is decidedly original and ingenious. It is the invention of Mr. Herman Dock.

It works on the motor and a pump principle, the pump supplying fluid to the motor in volume controlable at the will of the operator, thus controlling the speed of the motor Motor and pump are similar in construction, and will be understood by referring to the sectional view, Fig. 1 Fixed to the casing of the motor is an internal gear *A*, which is of quadrilateral form Mounted on a shaft at the center of the casing is an elliptical gear *B*, while between the elliptical gear and the internal gear are six planetary gears, 1, 2, 3, etc. The design of the internal gear is such that when the elliptical gear is revolved, the planetary gears will mesh with both the internal and the elliptical gears at all points The planetary gears will, of course, travel in the direction of rotation of the elliptical gear, owing to their contact with the internal gear The planetary gears may be considered the pistons of the motor, while the spaces between them are the cylinders It will be noted that the space between planets 1 and 2 is much greater than that between planets 2 and 3 As the planets progress in the direction of the arrows the volume of the cylinder space between pistons 1 and 2 diminishes, while that between pistons 2 and 3 will grow larger. Hence, if this be considered a pump with inlet and exhaust ports, the first cylinder will be discharging through port *C*, while the second cylinder will be sucking through port *D*. Conversely, if the apparatus be used as a motor, fluid admitted through port *D* will cause the pistons to progress so as to increase the cylinder space between pistons 2 and 3 while at the same time the fluid in the cylinders between pistons 1 and 2 will be discharging through port *C*. It is interesting to note that while the elliptical gear advances 135 degrees, the cylinders advance only 45 degrees, and while there are only six cylinder spaces, the machine operates as if it had eight cylinders, and there are eight discharge and inlet ports.

Fig. 2 shows how the mechanism is employed as a variable speed transmission. It consists of two parts, namely, a motor and a pump. The pump consists of two units. The internal gear of the motor is indicated at A^1, and the elliptical gear at B^1, while the internal gears of the pump units are shown at A^2 and A^3, and the elliptical gears at B^2 and B^3, respectively. One of the pump units is adapted to deliver fluid through the other pump unit. The internal gears A^2 and A^3 are adjustable one with respect to the other under control of the lever *E*, which operates a bevel pinion *F* meshing with beveled teeth cut on the adjacent faces of the gears

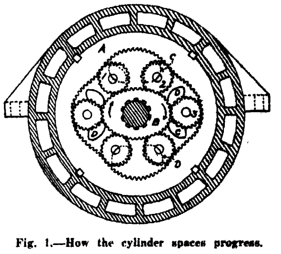


Fig. 1.—How the cylinder spaces progress.

Figs 3 and 4 show the results of adjusting one gear with respect to the other In the position shown in Fig. 3, one pump unit is indicated by full lines and the other by dotted lines, it will be seen that a cylinder of one pump member faces a discharging cylinder of the other, so that one takes in all the oil that the other discharges, and no fluid is delivered to the motor. When, however, the gears are moved to the position indicated in Fig. 4, the sucking cylinders of the two pump units pull together, and the discharging cylinders discharge together, consequently a maximum amount of fluid is delivered by the two pump units to the motor, and the latter is now driven at full speed. Any speed between maximum and zero may be obtained by relatively moving the two gears A^2 and A^3 between the extreme positions shown in Figs. 3 and 4.

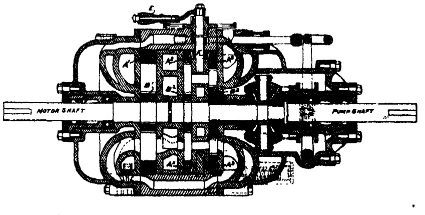


Fig. 2.—Longitudinal section of the variable speed gear.

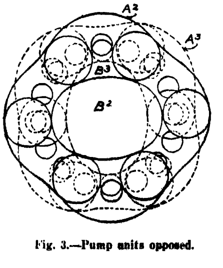


Fig. 3.—Pump units opposed.

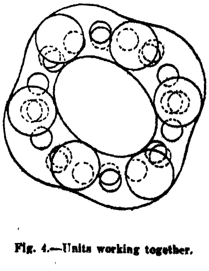


Fig. 4.—Units working together.

It will be noted that this is a true rotary in absolute mechanical as well as hydraulic balance, so that there is no pressure on any part that is not absolutely met with the exact pressure on the opposite side. In fact, if gears could be cut perfectly and would not wear, there would be no necessity for a bearing. Up to the present writing, no engineer in this country or Europe has been able to lay out the pitch line of the internal perfectly. It was found by the "cut and try" method and then master cutters were made.

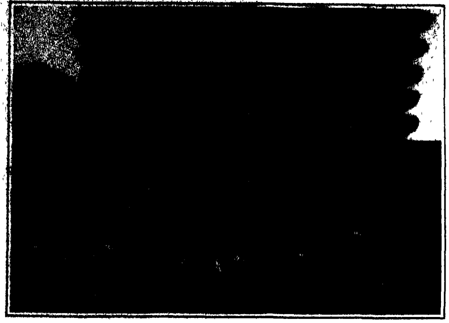
The accompanying photographs show a fire pump constructed on this planetary gear principle. Recently, on an endurance test of 100 hours, this pump, measuring only 9½ inches in diameter by 2⅛ inches in length, made 4,800,000 revolutions and delivered 1,100,000 gallons of water.

Counterfeit Weather Forecasts

ALTHOUGH the almanac weather prophet still plies his trade to-day, as he did hundreds of years ago when Justus Stöffler threw all Europe into a panic by announcing that certain planetary conjunctions would bring about a second deluge, it appears that there are legal snags upon which the modern prognosticator is in danger of running, if he happen to utter his predictions within the jurisdiction of the United States. Proceedings were recently brought in the United States court at Detroit against the publishers of a "Family Almanac" under a section of the Penal Code, which reads as follows: "Whoever shall knowingly issue or publish any counterfeit forecast or warning of weather conditions, falsely representing such forecast or warning to have been issued or published by the Weather Bureau, United States Signal Service, or other branch of the Government service, shall be fined not more than five hundred dollars, or imprisoned not more than ninety days, or both." On the title page of the publication in question appears the following statement: "Including a map of the United States and Uncle Sam's Weather Predictions." Needless to say, the predictions, which are made up for a year in advance, are not "Uncle Sam's." The publishers were found guilty and fined $100 for each of the three years during which the forecasts had been issued.

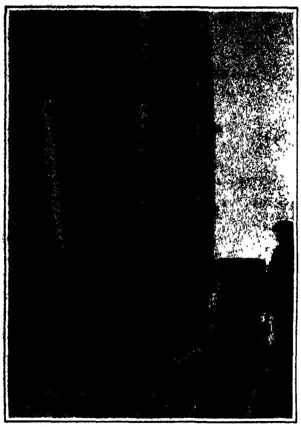
[illegible] Moving-picture Scenery

EXAGGERATION of the cost of moving-picture films is the rule rather than the exception, and so when we hear that a recent film has cost a quarter of a million dollars to produce, we are sure that the actual amount has been greatly overstated. Nevertheless, D'Annunzio's photo-play "Cabiria," it may readily be seen, involved an enormous expenditure. It rivals such plays as "Ben Hur" and "Quo Vadis," but differs from them chiefly in having been written particularly for the kinematograph. The author personally managed the staging of the play and, in order to have it as real as possible, the actors were engaged long before the final performance, in order that those who were to represent athletes could develop their muscles by gymnastic exercises, and those who were to represent bearded men could raise real beards, and thus avoid the usual wig and make-up. The story of the play belongs to the time of Hannibal and the scenes vividly portray the horrible religious rites of human sacrifice practised at Carthage, in the Temple of Moloch. Cabiria is a Roman girl stolen by Phœnician pirates and sold to the priest of Moloch, who is about to offer her as a sacrifice to the "God with the White-Hot Heart" when she is rescued. To stage the play, a most elaborate temple was built of plaster. The accompanying illustration represents the great gate of the Temple of Moloch. There are interior views of marble halls richly decorated and ornamented with representations of the sculpture of that time. *In addition to the scenes* at Carthage, there are views of Hannibal leading his army over the Alps, a Roman battle at Cirta with catapults, derricks, and all the machinery of ancient war. The pictures were taken in Italy, Sicily, Switzerland, Africa, and Spain.


Gate of the Temple of Moloch, constructed for a photo play.

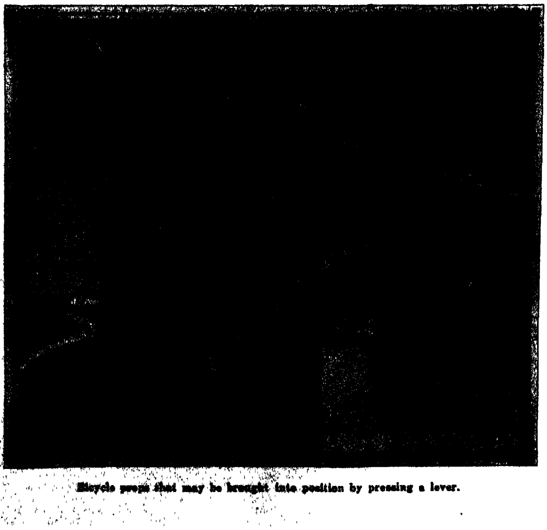
Machine for Sawing Stone Walls

THE modern builder thoroughly appreciates the importance of waterproofing foundation walls to prevent dampness from creeping into them and injuring them. Accordingly, it is the custom to protect the foundation walls with a good coating of asphalt or the like. However, there are many buildings, particularly in the older countries, in which no such provision against the entrance of dampness and frost was made. In order to preserve these buildings, a method of insulating them against dampness has been devised by a German engineer. It consists in sawing a slot in the foundation wall just above the ground line and introducing in the slot asphalt-coated lead plates. A special machine has been designed to saw the masonry, producing a kerf about one inch wide. As the work is done progressively, the plates being introduced as the sawing proceeds, the stability of the building is not endangered. However, to prevent any possible accident, conical iron cramps are introduced in the saw kerf. After the introduction of the insulating plates the slots are closed with temporary wooden forms, and then they are grouted with liquid cement, which completely fills them and any gaps still left open. The cement adds to the insulation, and the wall is thus thoroughly protected against creeping of moisture from the ground upward. To dry out the walls over the insulating plates, a special stove is provided.


Sawing foundation walls to introduce waterproofing plates.

Bicycle Fitted With Side Props

THE convenience in having a device for making a bicycle stand still when it is stopped on the road will be at once appreciated, for it will come into use in numerous cases when the rider wishes to stop without dismounting from his machine. Our photographs show a bicycle in this position, it being held by a forked support at the rear, and the various details of the device are also noticed. The supporting device is of a most simple kind, and is at once brought into use by pressing on a lever. On the lower tube of the bicycle frame and next the rear wheel hub is clamped a bracket. This serves to hold a light steel rod on either side of the machine, which forms the support The rod is journaled in the bracket, but, being a bent shaft, its lower leg takes the two positions shown in Figs 1 and 2, when it is turned in its bearing. In the first position the leg projects to one side as a prop, while in the second position it is folded up against the side of the wheel. All the movement is controlled in an easy manner, by the use of a lever. Various means can be adopted for placing this lever, but the best one is shown in Fig. 3. On the handle rod is mounted the usual brake, seen on the left, and next to it is a lever of quite similar kind, but somewhat differently mounted, so that by pressing the lever we pull on a wire in quite the same way as for the brake. This wire works in the customary flexible tube, and it goes down along the frame to the bent upper end of the pivoted rod or leg which we mentioned above. A double wire allows of working both legs at the same time. A spring upon the collar or support keeps the legs held up in the inactive position, and when the lever throws them upon the ground, a suitable clamp or lock device keeps them there, so that the hand pressure need not be further applied It will be seen that the device could hardly be simpler or easier to operate When on the road, it will now be possible to stop for a moment in order to enjoy a view, or even to take photographs, and for this latter use it will be most useful in allowing time-exposures to be made, the bicycle serving as a tripod. In cities and when traveling upon crowded streets where the rider becomes blocked by vehicles, he is able to stand still until free to proceed, without being obliged to dismount, as so frequently happens


Bicycle props that may be brought into position by pressing a lever.

News from the "Karluk"

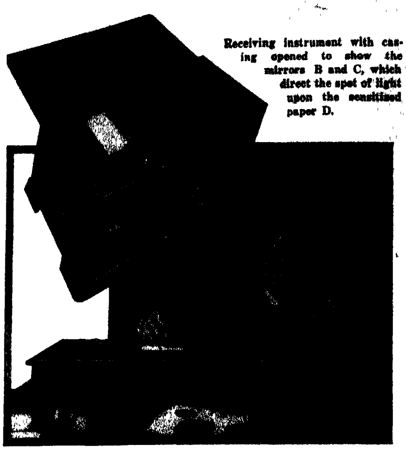
THE mystery which has enshrouded the fate of Vilhjálmur Stefánsson's ship "Karluk" since she drifted away from the Alaskan coast, September 22d, 1913, carrying with her about half the scientific staff of the Canadian Arctic Expedition, is now happily at an end. A dispatch from St Michael's, Alaska, announces the arrival at that place of the "Karluk's" sailing-master, Capt. Bartlett, with the news that the vessel was crushed by the ice and sank about sixty miles off Herald Island (northwest of Bering Strait) on January 11th. The ship's company escaped over the ice to Wrangel Island, from which point Bartlett sledged to the Siberian coast, where he fell in with the whaler "Herman," which carried him to St. Michael's As soon as navigation opens, the Canadian government will undoubtedly send a vessel to rescue the party marooned on Wrangel Island Much interest attaches to the course over which the "Karluk" drifted, as bearing upon the plans of Amundsen and others to approach the pole by drifting from a point north of Bering Strait The drift of the "Karluk" ended almost exactly where that of De Long's ship "Jeanette" began, in 1879, while the point at which the "Jeanette" sank was not very far from where the drift of Nansen's "Fram" began, in 1893 The combined routes of these three vessels thus give a general idea of the drift of the Arctic currents more than half way around the north polar basin. They are at once unfavorable to the plan of utilizing ocean currents as a means of reaching the pole, and favorable to the idea that extensive lands exist in the unexplored region of the Arctic Ocean News is now eagerly awaited of Stefánsson's proposed sledge journey northward from the Mackenzie delta and of MacMillan's northwest from Axel Heiberg Land; either of which may have resulted in the attainment of the lands in question.

Yellow Poplar, or tulip tree, the largest broadleaf tree in America, has been known to reach nearly two hundred feet in height and ten feet in diameter.

New Apparatus for Writing at a Distance

A VERY *ingenious apparatus* has just been introduced from Germany, which is designed to transmit writing, drawing, and the like over a telephone or telegraph line to an instrument which makes a perfect reproduction of the original. Telautographs have long been in use, but this apparatus differs from others in many important particulars The writing at the receiving end is done by a pencil of light which travels over a sensitized sheet of paper. The message is thus photographically reproduced, the sensitized paper being developed automatically, in the machine, in a few seconds' time

The scheme of the device is shown diagrammatically in Fig. 1 At the left is the transmitting station; the receiving station at the right The position of a point is determined by noting the length of its abscissa and of its ordinate, in relation to two axes, or, to borrow a geographical simile, by noting its latitude and longitude. It is therefore merely necessary to transmit the latitude and longitude to the receiving station in order to locate the same point on a sheet of paper at that place Accordingly, the pencil *P* is provided with means for *controlling two variable resistances* R^1 and R^2, respectively These, in turn, control delicate galvanometers G^1 and G^2, respectively, at the receiving station, each fitted with a tiny mirror As more or less resistance is thrown *into the circuit at* R^1, the mirror *B* of galvanometer G^1 is more or less deflected, and a beam of light from the lamp *A*, playing upon this mirror, has its reflection correspondingly deflected. The reflected beam is cast upon the mirror *C*, which is mounted to turn on an axis at right angles to that of mirror *B* Mirror *C* is deflected by variations in the resistance introduced at R^2, further modifying the direction of the beam reflected therefrom In other words, one of the mirrors determines the latitude of the point of light that falls upon the sensitized paper *D*, while the other controls its longitude Accordingly, as the pencil is moved over the paper at the transmitting station, the pencil of light at the receiving station must reproduce the same line, point for point, on the sensitized paper



Receiving instrument with casing opened to show the mirrors B and C, which direct the spot of light upon the sensitized paper D.

Transmitting a message with the photographic telautograph.

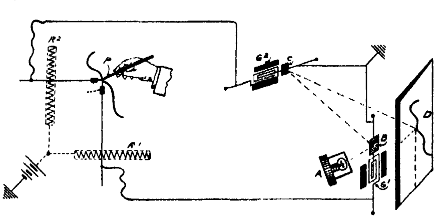


Fig. 1.—Diagram of the main circuits of the improved telautograph.

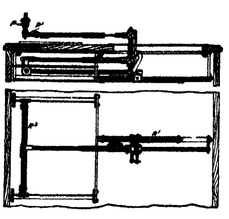


Fig. 2.—The transmitting pencil and resistance coils.

In the photograph of the receiving apparatus, the *place where the lamp is introduced is indicated by the* letter *A* The light from the lamp passes through a series of lenses and reflectors to the small mirror *B*, then to the mirror *C*, finally falling upon the sensitized paper at *D* The developing tank is shown at *E* After the message has been written, the machine automatically reels off the exposed paper, cuts it off, passes it through the developer, and issues it finally through the slot *F*, completely developed, fixed and dried, all in fifteen seconds

Detail views of the transmitting pencil and the variable resistance coils it controls are shown in Fig. 2, the upper view representing a side elevation, and the lower view a plan with the pencil and pencil arm broken away and the top of the casing removed The pencil is indicated at *P*, while at P^1 is an automatic contact which closes when the pencil is swung up to the writing position. The system is active only when the pencil is held in writing position and the lamp *A* glows only when the pencil is pressed down in contact with the paper. So the act of moving the pencil across the paper to dot an *i* or cross a *t* is not accompanied by a corresponding movement of the beam of light at the receiving station. As soon as the writer is through with his message, he lays down the pencil, whereupon contact P^1 is broken and the transmitting system becomes inactive, but the developing mechanism at the receiving station *begins to operate. Not until the message* has been developed can another message be written. If the operator should write a second message during the period of developing, no message would be transmitted. As soon as the receiving apparatus is ready for the second message, the fact is signaled by a disk on the transmitting apparatus, which shows white. Then the writer, on picking up his pencil and beginning to write, will hear a slight buzzing noise, indicating that the receiving apparatus is reproducing his message properly In other words, "he hears himself writing at the receiving station"

Referring again to Fig 2, the essential details of the transmitting station are clearly shown The pencil proper is supported upon an arm which passes through a slot in the top of the casing and is pivoted upon a carriage As the carriage slides back and forth in the slot, contact is made with the variable resistance coil R^1. As the arm swings upon its pivot, contact is made along the resistance coil R^2, which, it will be observed, *is mounted upon the wheels so that it can travel* toward or from the pivot, to adjust itself to the variable reach of the arm. One of the principal advantages of this apparatus is the fact that a message may be corrected; a word or a line may be inserted at any point after the message has been written, and not until the operator is satisfied that the writing is just as it should be, need he drop his pencil and have the photographic reproduction developed at the receiving end. This permits of transmitting drawings as well as ordinary writing. Instead of moving a pencil at the receiving end in frictional contact with the paper, there is the practically negligible inertia of two light mirrors. This permits of operating the device rapidly and accurately. The writing may be as small as desired, while the message received, being photographic, makes a fixed record that cannot be altered. The roll of photographic paper is sufficient to reproduce a hundred messages on sheets the size of a postal card. When the roll is nearly exhausted, warning is given by special marks on the last few sheets of paper, which will *serve to notify* an attendant that a new roll and a new stock of developer must be placed in the machine. Very little current is required to transmit a message over a mile or more.

Measuring Human Comfort

PROF. LEONARD HILL, F.R.S., and Mr. O. W. Griffiths have devised what they call a "caleometer," an instrument designed to measure the degree of comfort in a room, or a public hall, or a factory, in so far as that depends on the rate of cooling of the human body. The "coil," which is made of a wire having a temperature coefficient, forms one arm of a Wheatstone's bridge, the other arms of which are made of an alloy whose electrical resistance does not vary with the temperature. The bridge is balanced when the temperature of the "coil" is approximately that of the human body, the current being supplied from accumulators or from the main supply. Any tendency to variation of this temperature is checked by an automatic rheostat, worked by a relay, so as to diminish the current when the temperature rises, and *vice versa*. The indicator in the box shows at any instant the number of calories per minute supplied to the coil to keep its temperature constant. The coil can be placed at any distance from the indicator, to which any number of coils can be switched in succession, if necessary. Comfortable conditions are indicated by gentle oscillations of the pointer—about a mean value of 30 calories per minute. A low steady reading denotes monotony and oppressiveness; violent oscillations about a high mean value are evidence of excessive cooling by an unpleasant draught.

New Cathodic Glow Lamp

By Henri Marchand

IT has long been known that when a Geissler tube is subjected to an electric discharge, the negative electrode becomes hot, to a degree more or less marked, according to the intensity of the discharge and the current producing it. Based on this phenomenon, Dr. Greinacker, Zurich, has developed the new cathodic glow lamp here illustrated.

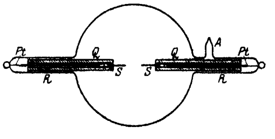


Fig. 1.—Construction of the cathodic lamp.

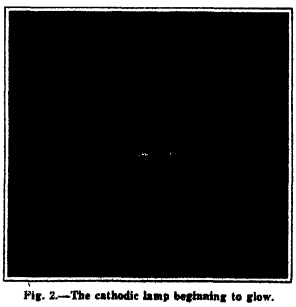


Fig. 2.—The cathodic lamp beginning to glow.

The lamp consists of a spherical glass bulb containing two electrodes (*SS*, Fig. 1), each consisting of a Nernst heater contained in a *quartz tube, and sealed in* by means of magnesia and pipe clay. Connecting wires of platinum are indicated at *Pt*, *Pt*. Air is drawn from the bulb, until the pressure is reduced to some millimeters of mercury

When the lamp is submitted to an alternating current of 1,000 volts, discharges take place, which soon heat the electrodes to a white-heat. With a current of, say, 0.1 ampère, the light furnished approximately equals that of a 50-candle-power lamp.

The voltage necessary for lighting the bulb will perhaps be diminished by using a suitable gas in the bulb, modifying conveniently the nature and pressure of the gas, etc. The appearance of the lamp when beginning to glow is shown in Fig. 2. The electrodes soon become incandescent.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Heating and Lighting.

EXTENSIBLE ELECTRIC LIGHT FIXTURE.—S. GARBRECHT, Idaho City, Idaho. The invention relates to suspended electric light fixtures employing a flexible suspending means, having a spring acted winding drum or barrel and a lazy-tongs composed of hollow members to receive the conductor wires. Novel means are provided for mounting and securing the winding drum, for guiding the extension elements and for preventing the lazy-tongs from swaying.

HEAT-INSULATED RECEPTACLE.—L. W. WHITE, Alzada, Montana. The receptacle combines the features of a sterilizing vessel and a fireless cooker. As a kettle it is provided with a lid adapted to be sealed for the purpose of retaining the vapors and flavors up to a certain desired high pressure. To form it into a fireless cooker, a special insulated bottom is provided which may readily be attached.

OIL BURNER.—G A. ULRICH, City of Mexico, Mexico. This oil burner is provided with a chamber for superheating steam before it comes in contact with the oil, to raise the temperature of the oil as it leaves the burner. The superheating is disposed over the mixing chamber and the steam from the superheating chamber is discharged below the outlet for the combustible mixture.

Household Utilities.

STOVE-KEY PLATE RATCHET-SUPPORT. J. E. LEONARD, 871 So. 19th St., Cedar Rapids, Iowa. The invention is an improvement in stove top plate ratchet supports and is designed to overcome objections to the ordinary support of this type, means being provided for supporting the plate with a variety of adjustments automatically operating by the movement of the plate. When the plate has been moved to an extreme position, it automatically disengages the ratchet mechanism and returns to normal position.

TABLE.—A. and L. RENZETTI, care of A. Alvino and Figle, 224 Lafayette St., New York. The invention relates to tables having adjustable tops whereby extra leaves may be added or removed when desired for increasing or decreasing the top of the table. The construction is such that the center of the top will always remain over the center of the pedestal of the table, thereby providing an even balance for the pedestal without the necessity of dividing the pedestal into parts.

PORTABLE AND FOLDABLE BATHTUB.—MRS. N. F. BONIFACE, 124 W. 44th St., New York, and SYMONA N BONIFACE, New York. This bathtub is designed for bathing babies, and is arranged to insure the utmost comfort of the baby while being bathed, to permit the attendant to fill and empty the tub conveniently, and to allow of turning the tub around, to facilitate the washing of the baby. The tub may readily be folded into a small bundle for storage or shipping purposes.

Of General Interest.

BALE BAND TIE.—I. M. THOMPSON, De Ridder, Louisiana. The invention provides a tie that may be applied quickly and removed readily. It is so formed that the band will hold the tie in place with only the slightest assistance from a spur or projection extending from the tie into the bale to which the tie is connected.

HANDLE ATTACHMENT. - W. H. JAYNE, 414 East 23rd St., New York, N. Y. Mr Jayne's invention relates to handles removably associated with a brush or similar article, the top of which article is also removable The object is to provide an additional handle attachment for brushes which may be used for different articles, provided with means for engaging a handle.

ANCHOR FOR SUBMARINES.—G. E. ELIA, Hotel de Crillon, Place de la Concorde, Paris, France. The invention provides a means for automatically locking the mooring winch when the anchor for a submarine mine reaches the desired position at the bottom of the sea, in order to render the length of the mooring cable independent of eventual displacement of the anchor under the influence of currents or other causes

BLANK BOOK.—S. R. CLARK, care of Spalding City Bank, Spalding, Neb. A combined register and ledger is provided by this invention which is arranged to afford convenient means for posting the sales in the ledger at the time they are entered upon the register. It comprises a set of leaves constituting the ledger and another set the register, the leaves being on a common writing surface in sight of the user.

THERAPEUTIC DEVICE.—C. E. MACARTHY, 228 West Chappel St., Griffin, Ga. The device comprises two levers pivoted together and arranged opposite each other, the inner sides of their longer arms being curved outwardly and a spiral spring interposed between the shorter arms of the jaws, which are extended in the same plane with their longer arms.

BURIAL STRUCTURE.—F. M. ROGERS, care of E. Nicholson, 78 Madison St., Seattle, Wash. This burial structure consists of a chapel in which burial services may be held, a receiving vault for temporarily receiving bodies, and thoroughly ventilated crypts as a final resting place for the bodies. In the floor of the chapel is an opening normally closed by an elevator platform on which the burial casket may be supported. The elevator provides access to the receiving vault underneath the chapel and the wings extending outwardly therefrom.

SUBMARINE MINE.—G. E. ELIA, Rome, Italy. An object of the invention is to provide a floating cable with mines suspended at each end, so that the cable when struck by the bow of a ship will be dragged along with the latter, so as to cause the mines on the ends of the cable to be drawn inwardly and into contact with opposite sides of the hull of the ship, when the mines will be exploded, with the effect of destroying the ship.

SMOKER'S POUCH—C. TWINING, 39 Leonard St., New York City, N. Y. The invention provides a smoker's pouch consisting of an outer envelope and an inner envelope, adapted to be disposed within the outer envelope, the latter being provided with means for holding a pipe, while the inner envelope constitutes a container for the tobacco.

DISPLAY RACKS FOR WINDOWS.—M. R. WOOD, 218 William Street, New York With the object of displaying merchandise to best advantage in show windows, the present invention consists of a bracket which may be secured to the casing of the window and a tubular arm with interlocking means for attaching the arm to the bracket, so that the arm will project therefrom at an acute angle.

METHOD OF COLLECTING PARTICLES PRESENT IN AN IONIZED MEDIUM.—W. W. STRONG, care of Scientific Instrument and Electrical Co., Mechanicsburg, Pa. The purpose of this invention is to provide a method of indicating the presence of smoke, dust, fumes, mist, or other particles present in flues and pipes as a means of checking the time when they are given off through the flues and the pipes and the relative amounts of the particles at such time. The invention is based upon the ionization of different media and proceeds upon the fact that particles present in an ionized medium may be collected through the use of an electric field.

APPARATUS FOR DRYING WASHED BIRDS, DOGS, AND OTHER ANIMALS.—R. G. FURLEY, address Day, Davies & Hunt, 321 High Holborn, London, W. C., England For the purpose of drying washed birds, dogs and other animals when intended for show purposes, in a quick and efficient manner, the present invention provides a cylinder divided into compartments by screen partitions, also an air-heating chamber, and an air-extractor, to draw the air through the cylinder.

PAPER CASE.—M. W. FASSMANN, P. O. Box 385, Fayetteville, Ark. This invention relates particularly to cases adapted and intended for holding rolls of paper, and particularly useful as a receptacle for mileage tickets, stamps, cigarette papers and other articles requiring the delivery from time to time of sheets or strips of paper.

FIRE ESCAPE—A. F. JONES, Nelson, Butte Co., Cal. This invention avoids marring buildings; provides a movable fire escape operable from a station accessible to an operator standing on the ground; provides means whereby the operative position of the escape is ascertainable without recourse to the escape directly; provides a structure arranged to prevent the parts thereof from becoming jammed or locked, and provides an escape for every window in the side of a house.

DEVICE FOR STACKING MAIL MATTER.—E. P. F. THOMPSON, Troy, Tex. This invention has reference to a device for use in stacking letters, circulars, newspapers, and other mail matter ready for tying in bundles. It is the design of the improvement to provide an article simple in construction, efficient in use, and capable *of being folded into small compass* when not required for use.

WIND SHIELD FOR MATCH BOXES.—F. C. LAMBERT, 242 E. Tremont Ave., Bronx, N. Y., N. Y. This wind shield is arranged for convenient attachment to match boxes, such, for instance, as contain safety matches in a drawer slidable in a casing, the wind shield when not in use folding upon the casing, and when extended for use permits of safely igniting a match for lighting a cigar or other article.

REMOVAL OF WATER FROM WET CARBONIZED PEAT.—N. TESTRUP, 6 Broad Street Place, and O SÖDERLUND, "Fairlawn," Clarence Road, Chapham Park, London, England. Externally and preferably slowly applied sustained pressure is used in removal of the water. This treatment preferably following a preliminary treatment in which pressure applied internally is used, i. e., pressure transmitted by the fluid itself. For this purpose, the wet material may be passed into a filter press and the water which is readily expressible therein removed in this way, a further quantity of water being then removed by subjecting the cake to pressure externally applied by a band or like press.

DENTAL CROWN REMOVER.—R. H. TAYLOR, Meeker, Colo. This inventor provides means for removing crowns or coverings from teeth by careful and painless application of force, to lift the cap or covering from the tooth to which it was applied; applies the force necessary for the removal of the crown or covering, at a distance from the tooth, for the convenience of the dentist; and provides a guide-plate from the tool having a peep-hole opening to guide the placement of the tool.

PIPE CAP.—S. N. MALTEENER, Canton, N Y. In this instance means are adapted to engage exteriorly with the bowl whereby the latter will not be defaced. The cap serves to prevent the lighted tobacco from being blown out of the bowl, especially when traveling or automobiling or in windy weather, although the improved cap will prevent extinguishing of the lighted tobacco in stormy weather and will serve to permit the proper draft and burning of the tobacco.

GUN SIGHT.—J. R. STEWART, 1111 A St., Tacoma, Wash. The inventor provides a sight of strong construction, and contrasting colors, whereby the sight can be used efficiently under different light conditions. He makes a perfect connection between the head and the support for the same, so that the vibration of the barrel caused by the discharge or any other rough, hard usage will not dislodge the head from the support.

Machines and Mechanical Devices.

SAW TENSIONING AND STRAIGHTENING MACHINE T W ROACH, Lyman, Wash. The invention relates to a machine for operating on circular and other saws, for performing the work known as rolling saws for tension, the machine being useful also for straightening a concave saw that has been forced over the saw collar The present invention provides an improvement on a saw tensioning and straightening machine previously patented by Mr. Roach

SAW GUIDE.—C. DEVERELL, Woodstock, Ore. The invention provides a device for supporting a cross-cut saw for making kerfs on the under side of the log with the saw in inverted position The construction is such as to possess more strength and simplicity than devices ordinarily employed, while eliminating devices which are liable to become broken or disarranged

GUIDE FOR SHARPENING BITS.—H. H. HOLMES, 527 Broadway, Council Bluffs, Iowa In order to hold planing bits in proper position while they are being sharpened, Mr. Holmes has invented a support having means for securing the bit thereto and a roller member associated with the support, forming means whereby the desired cutting angle of the bit is obtained when the plane is sharpened.

EXPENSE TABULATOR—E L. BROWN, care of Alfred R Rodway, 100 Hudson St, New York, N Y This invention refers to an expense tabulator which is intended primarily for use by traveling salesmen, whereby each expense as it is incurred can be easily and conveniently recorded on a strip of paper or other table contained in the device for daily or weekly records, there being a suitable printing mechanism that is adapted to be manipulated for printing on the tape various items of expense and amounts thereof.

INTERDECK DAVIT--R. TJADER, 51 E 42nd St, New York, N Y. The invention more definitely stated provides an easily controllable and safe means for launching life boats from various decks or between decks of a ship, whereby the confusion and loss of time incident to attempting to launch all the life-boats from the upper deck only are obviated

QUARTZ MILL—H F RANDALL, Tiffin, Ohio. An object of the invention is to provide a device having shoes disposed on a frame which may be oscillated in a horizontal plane A further object is to provide a device of this type, in which the horizontal oscillating frame may have a vertical movement, so as to ride over and crush larger pieces of the rock

CAN TOP FEEDER—C E FORRY, address H L. Guenther, care of Angelus Sanitary Can Machine Co, 310 North Ave 19, Los Angeles, Cal. The can tops are taken, one by one, from the bottom of a stack, a separator being provided *to prevent more than one from being* taken at a time, and then they are caught by the arms of a feed wheel, which carry them to the point of delivery.

Prime Movers and Their Accessories.

GEARING.—J M J NESS, care of Dakota Implement and Hardware Co, Maddock, N D The object of the present invention is to provide a device of a simple nature for converting the rotary motion of a windmill into reciprocating motion for working the pump rod The device is so designed that the gearing is enclosed in an oil reservoir, securing perfect lubrication.

OILER.—A. SCHOBL and A. E. BAUM, 42 Lafayette St., Waterloo, Iowa. Most of the windmills which have been in use for several years are so badly worn that it is difficult to connect with them any of the oilers now in use in such a manner as will insure an even and certain feed of the lubricant at all times This fault is removed by the present invention, which provides for a positive delivery of the lubricant under all conditions.

ENGINE STARTER—B G. PATTERSON, 1138 W. 14th St, Oklahoma, Okla This invention relates particularly to so-called "self starting" mechanism for automobile engines The engine shaft is spirally grooved at the forward end and carries a nut engaging these grooves. The driver operates a lever to draw the nut back along the shaft, causing the latter to rotate and turn the engine over, whereupon the nut is released by a ratchet mechanism.

Railways and Their Accessories.

RAILWAY SAFETY AND RECORDING DEVICE.—F. F. HUDSON, Memphis, Tenn. The invention comprises a train stopping mechanism, controlled by a closed track circuit, which will cause the stopping of a train by the application of brakes, and will also give warning in the cab of the engine to notify the engineer or fireman of impending danger. A recording device will record the obedience to or disobedience of signals by the engineer

CROSSING ARRANGEMENT FOR BLOCK SIGNAL SYSTEM.—MARK CONRAD and W G KELLY, Adrian Michigan An object of the present invention is to provide an arrangement for preventing a collision of trains at the crossing of two roads, either one or both of which are equipped with a block signaling system. Means are provided by which the circuits are closed through the operation of crossing signals so as to supply current for certain train stopping mechanism carried by the engine

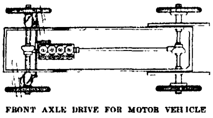
LOCOMOTIVE DRIFTING VALVE W J. SAXON, 92 West 30th Street, Paterson, N J The invention provides means for supplying the cylinder and steam chest of locomotives with saturated steam to avoid the drying and sudden cooling incident to the heat of the superheated steam and the vacuum formed by the movement of pistons Means are also provided for cushioning the pistons after the determination of the power steam supply in the cylinder.

Pertaining to Recreation.

APPARATUS FOR AQUATIC INSTRUCTION AND AMUSEMENT—C S JACOBSEN, 587 Pacific Street, Brooklyn, N Y A novel apparatus for instruction in the art of swimming is provided by this invention. It embodies a large swimming pool having a circular concentric platform adapted to travel on the sidewall or rim of the tank, the same being operated by a suitable motor and also provided with means for supporting persons in the water, the element of danger being thus entirely eliminated

Vehicles and Their Accessories.

FRONT AXLE DRIVE FOR MOTOR VEHICLE.—E R NICHOLS, 5716 Washington Ave, Chicago, Ill The present invention comprehends an improved means for driving a motor vehicle and especially a farm tractor through a shaft carried by the front or steering axle An improved universal joint is provided between the main part of the front axle and the spindle end so as to increase the pulling power and enable the tractor to turn short Irregular motion of a universal joint on one side is neutralized by that on the other, so that motion of the tractor is uniform



FRONT AXLE DRIVE FOR MOTOR VEHICLE

EMERGENCY AXLE—C P. SNYDER, 69 Dowel Street, Slatington, Penn The invention provides an emergency appliance adapted to be carried in the tool chest of an automobile and so constructed that in case of breakage of one of the driving axles, the wheel may be removed from the broken part and the emergency appliance connected to the remaining part of the axle and the wheel then connected to the emergency device

HOLDER—A HARNISHFEGER, care of M A Strouse, Main and 2nd Sts, Evansville, Indiana This holder is adapted for use on the side or rear of *an automobile for carrying one* or more extra tires each held on a demountable rim, or for carrying wheels and the like The holder is arranged to take up very little room, to prevent articles from being removed by unauthorized persons and to allow of quickly removing the articles when needed

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The World's Largest Locomotive

(Concluded from page [illegible])

tive, has 1,584 square feet of surface.

An interesting fact is that this locomotive has 89 per cent of the total weight of the engine and tender on the drivers, a gain which results from placing a set of driving wheels under the tender. The boiler contains 326 tubes 2¼ inches in diameter and 53 tubes 5½ inches in diameter, and their length is 24 feet. There are 6,418 square feet of heating surface in the tubes, 88 square feet in the arch tubes, and 380 square feet in the firebox and combustion chamber, making a total heating surface of 6,886 square feet. The superheater having a total heating surface of 1,584 square feet, makes the total equivalent heating surface 9,262 square feet. The grate area is 90 square feet.

The tender has a capacity of 10,000 gallons of water and of 10 tons of coal.

The exhaust steam from the right center cylinder passes to the front receiver pipe, and that from the left exhaust chamber to the rear receiver pipe. These pipes have ball and sliding joints which insure flexibility. The front low-pressure cylinders exhaust through the stack through a flexible pipe, and the rear low-pressure exhaust is carried through a feed-water heater, extending the full length of the tender, and is then discharged through a vertical pipe at the rear of the tank.

As showing how, even in mechanical matters, history will sometimes repeat itself, it is interesting to note that as far back as 1863, Archibald Sturrock, locomotive superintendent of the Great Northern Railway, in England, conceived the idea of utilizing the weight of the tender for traction, and built about fifty locomotives which carried an engine and drivers in the tender frame. A photograph and a line drawing by Mr. Herbert T. Walker of this early and most interesting locomotive are shown in the accompanying illustration.

In the Sturrock engines the weight of the tenders loaded was about 57,000 pounds The middle axle was cranked and driven by a pair of inside cylinders, 12 inches in diameter by 17-inch stroke. The wheels were 48 inches diameter and were connected by outside coupling rods.

Steam for the tender engine was drawn from the main engine boiler and was controlled by a separate throttle valve. It was conducted to the tender cylinders through a pipe (visible on the photograph) from the outside of the steam dome. In practice this pipe was found sufficiently flexible without the intervention of compensation joints. The valve gear was the ordinary Stephenson link motion worked by a separate reversing lever on the tender.

The exhaust steam was delivered into a tubular condenser, which was surrounded by the water in the tank, and what remained uncondensed passed away through two short outlet pipes at the rear of the tender. These and other details are clearly shown in the accompanying drawing.

The tractive effort of these tenders was about 5,600 pounds. The engines to which they were attached were the ordinary English freight locomotives of the period; but their heating surface was slightly increased to supply the necessary steam to the tender cylinders. The leading dimensions of the engines were: Cylinders, 16 inches diameter by 24 inches stroke. Driving wheels, 60 inches diameter. Total heating surface, 1,082.26 square feet. Weight in working order, 73,900 pounds.

The tractive effort of the engine was about 11,264 pounds, which, added to that of the tender, made a total drawbar pull of 16,864 pounds.

The hauling power of these steam tender locomotives was nearly double that of the ordinary engines of the same class; for on a level road they drew sixty loaded cars, while the latter could pull only thirty-five cars on the same track.

Although a mechanical success, they were in advance of their time, for the trains they hauled were too long to be handled with convenience, since their length exceeded that of the side tracks. Moreover, on down grades the longer

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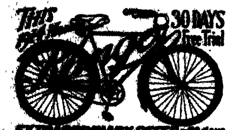

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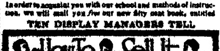

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tenders were difficult to control with the inadequate braking power of fifty years ago. Another reason for their failure was that the tender caught the dust and grit from the engine, making the repair bills heavy.

Finally, the enginemen complained that they had practically two engines to care for instead of one, and their disfavor doubtless contributed to the want of success of these tenders, which, as Zerah Colburn (then the greatest authority on locomotive engineering) said, "deserve to be remembered as a contribution to the practice of auxiliary power."

The Launch of "Shamrock IV"

(Concluded from page 482.)

indeed, that it was necessary to provide extension chain plates in order to get sufficient spread for the shrouds to hold the towering rig in place. A novelty in the rig is the fact that some of the shrouds lead to a point one third of the distance from the masthead; and midway between their point of attachment and the deck is a second pair of spreaders. This method of staying suggests that the mast must be built extremely light in plating.

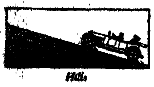
According to Winfield M. Thompson, the yachting expert, who is at Gosport for the purpose of observing the "Shamrock," she will have a sail spread of about ten thousand square feet. If this be true, the sail area will exceed that of "Resolute" by nearly 25 per cent, which is a truly enormous difference. The penalty due to her great sail spread and to the quarter-beam limitation will be large; and it becomes an interesting question whether the great power of "Shamrock IV" will suffice to wipe out the handicap she must give to whichever American boat is chosen, and still have in hand a sufficient margin of speed to make her the winner of three out of five contests off Sandy Hook.

Gustav Hamel

By Major H. Bannerman Phillips

THE finest of Great Britain's fliers lost his life in the attempt to cross the English Channel on May 23d, on his way from Paris to Hendon, where he was to have flown in the "aerial derby" on the afternoon of that day. The race was to start from there about 4 P. M., and after following a more or less triangular course around London, was to finish again at Hendon. Mr. Hamel had gone to Paris in order to fly over to England in the Morane-Saulnier monoplane with 100 horse-power Gnôme engine, with which he intended to compete in the race. He left Villacoublay at 4:30 A. M., landing at Le Crotoy, near Lille, about an hour later. He was afterward reported as having landed at Hardelot, and later at Boulogne. He is said to have left the latter place at half-past 1 o'clock, and afterward to have been seen over Calais. After that all traces of his flight were lost. The weather in the Channel on the 23d was extremely unfavorable for flying. There was a thick mist and a strong westerly wind, and the airman would have known well the significance of this state of things, for he had crossed the Channel in flights about twenty times during his career as an aviator.

The most complete and thorough search was commenced as soon as it was known that there were fears as to his safety. Various cruisers and destroyers and two sea-planes of the British Navy commenced to search the sea for traces of him, and the nature of the weather may be judged from the fact that both sea-planes were wrecked and the rough seas made hard work for the crews of the destroyers as they and the cruisers slowly patroled the Channel and swept the surface of every portion of the sea between England and France, where there seemed to be the slightest chance of finding any clue to the fate of the intrepid airman. The search was continued, both by day and night, as long as there seemed any chance of success, the various vessels keeping touch by wireless all the time. The watch and passengers on the cross-channel steamers also keep a lookout for any pieces of wreckage, and the French and English coasts were


Hills

Heavy Roads

Boulevards

Every-day tests of your lubrication Try them on nearby roads

How soon does incorrect lubrication show up?

Often in one short run.

Consider three types of roads:

Hills. You come to a sharp grade. With one lubricant you must drop to a lower speed. With another lubricant you can climb the hill easily.

Why?

Because the first lubricant is wrong in *body*. Compression and explosion escape past the piston rings. Power is wasted. If the oil is low in *quality*, you must also overcome excessive friction.

Only oil correct in *body* and *quality* will give you full power for the hills.

Heavy Roads. The conditions are very similar to those in hill *climbing*.

Sand, mud or "rough going" bring heavy strains to the motor.

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CARS	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Abbott Detroit	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
Alco	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
American	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Autocar (2 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
(4 cyl.)	A	B	A	Arc	A	Arc				
Avery	A	B	A	B	A	A	A	A	A	A
" (Model C)									Arc	Arc
Buick (2 cyl.)	A	A	A	A	A	A	A	A		
(4 cyl.)	Arc	Arc	A	Arc	A	Arc	A	Arc	A	Arc
(6 cyl.)									A	Arc
Cadillac	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cartercar	A	B	A	B	A	B	A	B	Arc	Arc
" Com'l	A	B	A	Arc	A	Arc	A	Arc		
Case			A	A	A	Arc	A	Arc	A	Arc
Chalmers	Arc	Arc	A	Arc	Arc	Arc	Arc	Arc	A	A
Chase (air)	B	B	B	B	B	B	B	B	B	B
" (water)									Arc	Arc
Cole	Arc	Arc	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Delaunay-Belleville	B	A	B	A	B	A	B	A	B	A
E M F	Arc	Arc	Arc	Arc	Arc	Arc				
Empire	A	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
Fiat	A	A	B	A	A	A	B	A	B	A
Flanders	E	E	E	E	Arc	Arc				
" (6 cyl.)							Arc	Arc		
Ford	A	Arc	E	E	E	E	E	E	E	E
Franklin	B	Arc	A	Arc	A	Arc	A	Arc	A	A
" Com'l	B	A	B	A	A	Arc	A	Arc		
G M C Truck					Arc	Arc	A	Arc	A	Arc
Havers			A	Arc	A	Arc	A	Arc	A	A
" (Model 6-44)									Arc	Arc
Haynes	A	E	A	Arc	A	Arc	A	Arc	A	Arc
Hudson	Arc	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Hupmobile (Model 20)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
(Model 32)							A	Arc	A	Arc
I H C (air)							B	A	B	A
(water)							A	A	A	A
International	B	A	B	B	B	A				
Interstate	A	E	A	Arc	A	Arc	A	Arc		
Jackson (2 cyl.)	A	A								
(4 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
(6 cyl.)									Arc	Arc
Jeffery									A	A
" Com'l					Arc	Arc	Arc	Arc	Arc	Arc
Kelly			Arc	Arc	Arc	Arc	Arc	Arc	A	A
King			A	B	A	B	A	B	A	A
" Com'l									Arc	Arc
Kissel Kar	A	E	A	Arc	A	Arc	A	Arc	Arc	Arc
" " Com'l			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
(Model 48)									A	A
Kline Kar	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Knox	B	A	B	A	B	A	B	A	B	A
Krit	A	A	A	A	A	A	A	A	A	A
Locomobile	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	E	E
Lozier	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Mack	A	E	A	E	E	E	E	E	A	E
" (Model [illegible])							A	A	A	A
Marion	A	E	A	E	A	Arc	A	Arc	Arc	Arc
Marmon	A	E	A	Arc	A	Arc	A	Arc	A	Arc
Maxwell (2 cyl.)	E	E	E	E	E	E				
(4 cyl.)	E	E	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
(6 cyl.)							Arc	Arc	Arc	Arc
Mercer	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Mitchell	Arc	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Moline	A	E	A	Arc	A	Arc	A	Arc		
Moline Knight									A	A
Moon (4 cyl.)	A	E	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
(6 cyl.)									Arc	Arc
National	A	A	A	A	A	A	A	A	A	A
Oakland	A	E	A	Arc	A	Arc	A	Arc	Arc	Arc
Oldsmobile	A	E	A	Arc	A	Arc	Arc	Arc	Arc	Arc
Overland	A	E	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Packard	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Paige Detroit	E	E	A	Arc	A	E	A	E	A	A
Pathfinder							A	Arc	Arc	Arc
Peerless	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Pierce Arrow	Arc	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
" " Com'l			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Pope Hartford	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Rambler	A	A	A	Arc	Arc	Arc	Arc	Arc		
Regal	A	E	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Renault	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Reo	A	E	A	Arc	A	Arc	A	Arc	A	Arc
Saxon									B	B
S G V			B	Arc	B	Arc	B	Arc	A	Arc
Selden	A	E	A	E	Arc	Arc	Arc	Arc	Arc	Arc
Simplex	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Speedwell	Arc	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
" Mead							A	Arc	B	A
Stearns	Arc	Arc	A	Arc	A	Arc				
" Knight					A	A	A	A	B	A
Stevens Duryea	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Stoddard Dayton	Arc	Arc	A	A	A	A	A	A		
" " Knight					A	A	A	A		
Studebaker	E	E	A	Arc	Arc	Arc	A	Arc	A	Arc
Stutz					Arc	Arc	Arc	Arc	A	A
Velie (4 cyl.)	A	E	A	Arc	A	Arc	A	Arc	A	Arc
(6 cyl.)									Arc	Arc
Walter	A	E	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

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examined by searchers of either nation, the French authorities taking an equal interest with the British in the operation, but all in vain.

From what is known of the route taken by Mr. Hamel, it seems probable that, in the first instance, he meant to strike the English coast at Hastings, but found the fog unfavorable to the longer sea-passage and then went farther east, in order to follow the Calais mail-steamer across and thus shorten the sea-journey as much as possible. The steamer having left when he reached Calais, he may have started for Dover, hoping to do the twenty-one miles in as many minutes, but getting caught by the fog, may have lost direction and been carried out of his course and over the North Sea, and finally, when his fuel gave out, he would be forced to come down out of sight of land, when his fate would be sealed. His monoplane was without floats, being intended for overland work, and it could not sustain him long on the surface of the sea, in any case. The circumstances of the voyage bear a painful resemblance to the last journey of the late Mr. Cecil Grace, who was lost in December, 1910, on the return over-sea flight from Calais to Dover in foggy weather.

Mr. Hamel was certainly the most experienced and the most distinguished of Britain's airmen, and he was, deservedly, one of the most popular, partly on account of his achievements, but also on account of his fine manliness and simplicity, to which was added a peculiar charm of manner. He was 25 years of age, and had displayed the greatest aptitude as an aviator of any man of his time; for since he qualified as an airman at Pau in 1911 he had shown himself to be as proficient in cross-country as in exhibition flying, and seemed to have a natural affinity for and knowledge of the air. He was the first pilot to cross the Channel with a lady as passenger, and also the first airman to make the London-to-Paris journey with a passenger in one day, and the first British airman to "loop the loop." He was looking forward with keen ambition to make the first attempt to cross the Atlantic in the Martinsyde monoplane which was being built for the purpose at the cost of Mr. E. Mackay, and which will be described at length in one of the forthcoming issues of the SCIENTIFIC AMERICAN. That his services in the cause of aviation from a national and patriotic point of view were duly appreciated, not only by the British public but by the government, was shown by the following communication in which the Admiralty made known their decision to abandon the search for traces of him on the 26th of May: "It has been decided to suspend the searching operations by flotillas and air-craft which have been in progress for the last forty-eight hours for Mr. Hamel. In relinquishing this quest, the Admiralty desire to place on record their recognition of the services rendered to British aviation by the missing airman. He was without question the foremost exponent in these islands of an art whose military consequence is continually increasing. His qualities of daring, skill, resource, and modesty merited the respect of those who pursue the profession of arms, and his loss, if this must be accepted, is received with deep regret by the officers and men of the Naval Wing of the Royal Flying Corps."

New Meteorological Units in Great Britain.

SINCE the first of May the daily weather reports of the British Meteorological Office have published all barometric pressures in millibars, instead of inches; rainfall in millimeters instead of inches; and wind velocities in meters per second instead of miles per hour. The vertical component of solar radiation, as measured at South Kensington, is given in joules per square centimeter, and its rate in milliwatts. Temperatures, however, are still given in these reports in the old-fashioned Fahrenheit degrees. The Royal Meteorological Society has decided to use millibars in the series of pressure normals for the British Isles, which it is now preparing. The barometers hereafter issued by the Meteorological Office will be graduated in both baromils and inches. (The baromils of the scale-reading are reduced to millibars, or absolute units of pressure, by applying appropriate connections.) Another new unit now used in Great Britain is the leometer (pronounced with the stress on the penult). This is defined as "the potential energy of unit mass raised through 1 meter against an acceleration of one 'leo,' or of unit mass raised through $1/g$ meters against the acceleration of gravity," and is a substitute for Prof. Bjerknes's "dynamic meter." The new unit of acceleration, 1 dekameter per second, is named "leo," in honor of Galileo. The leo and the units derived from it were introduced by Mr. J. W. Whipple, of the Meteorological Office.

An Industrial Education Convention

THE second convention of the National Association of Corporation Schools will be held in Philadelphia from June 9th until June 12th, inclusive. The first convention, held last Fall, took place at Dayton, Ohio; the meetings were held at the National Cash Register building. The meetings of the coming convention will be held in the new auditorium of the Curtis Publishing Company, at Sixth and Walnut Streets.

The National Association of Corporation Schools is an association organised for the furthering and developing of industrial education by employers. Its members are the corporations and firms who have taken positive steps in the forwarding of industrial training by organizing schools in which their new employees are taught what to do and their old employees are trained to higher degrees of efficiency.

Its field of operation lies right alongside the field of operation of the National Society for the Promotion of Industrial Education. The purpose of the National Society is to develop industrial and vocational training in the public schools. The National Association begins where the National Society stops; it takes the public school graduate just entering business and trains him for the particular work of the concern into whose employ he is entering. The purpose of both organizations is to train the man to be of the greatest value to society and business and to enable him to *earn* the largest possible salary.

For the past hundred years the efforts of the great minds of business have been directed to developing and improving the mechanical agencies of production, trade, and commerce. In the agricultural districts, the steam reaper and harvester do the work of hundreds of hands. In factories, every effort has been bent to produce labor-saving machines of greater and greater efficiency. Sixty years ago the "Clermont" ran up the Hudson; now we have the "Vaterland" and the "Aquitania."

It is recognized, in fact, that in our strivings to improve the machines and methods over which our employees are to exercise control, we have taken no steps to improve the employees themselves. Quality of production is not the result of machinery alone, but of brains as well. And we have not taken the trouble to train the brains. From now on it is a man problem.

The realization of the one-sidedness of this development is what has prompted the organization of the National Association of Corporation Schools.

The Curtis Publishing Company, a member of the association, will act in the capacity of host to the visiting delegates at the sessions. Among speakers at the convention will be Arthur Williams of the New York Edison Company, president of the association; E. St. Elmo Lewis, of the Burroughs Adding Machine Company, and Charles P. Steinmetz, of the General Electric Company.

The meetings of the convention will be open to representatives of any business houses who are interested in the possible adaptation of industrial education to their own work and who will be interested in hearing the discussion and in talking with the members.

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The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement

Possible Addition of Three Battleships This Year

IF the present negotiations and plans of the Navy Department do not miscarry, it is quite possible that provision will be made for the construction this year of three dreadnoughts. The two-battleship programme is certain of adoption, and, also, thanks to the pressing needs of one of the smaller European powers, it seems likely that the Government will authorize the building of a third capital ship of the largest size and power.

The purchase of a large modern battleship by Turkey has made it necessary for the Greek government greatly to strengthen its navy, if it is to hold its present superiority over the navy of its ancient foe. Negotiations have been opened for two of our pre-dreadnought ships, the "Idaho" and the "Mississippi," and the price which is named will be just about sufficient to cover the cost of a ship of the same class as the "Pennsylvania."

Of the more modern of our pre-dreadnought battleships, the "Idaho" and the "Mississippi" are the two which can be best spared; and this, not for the reason that they are not of first-class quality, but because they are what might be called an odd size and do not fit in well with our other ships of approximately the same date. The "Idaho" and "Mississippi," which are sister ships, were built under an authorization by Congress, in which, unfortunately, their displacement was definitely limited to 13,000 tons. They are small editions of the "Louisiana" and "Connecticut," the difference being that they are of 3,000 tons less displacement and of one knot less speed, that their armor is lighter, and that their broadside secondary battery is weaker by the omission of four 7-inch guns.

Except for these differences, they may fairly be considered as of the "Connecticut" class, and, therefore, they are thoroughly representative of the period immediately preceding the advent of the dreadnought. In fact, they were laid down the same year in which the first dreadnought was being constructed. Each ship carries four 12-inch 45-caliber guns and eight 8-inch 45-caliber guns in turrets, and eight 7-inch guns in a broadside battery on the main deck. Each ship has two submerged torpedo tubes of the new 21-inch type. The best recent speed of the ships has been a trifle over 17 knots. They are protected by a 9-inch belt associated with a 3-inch armored deck, and they have from 12 to 8 inches of armor on the turrets. The lower deck and the main deck in the wake of the 8-inch battery are protected by 7 inches of armor.

The purchase of these two battleships would mean a very great increase in the fighting strength of the Greek navy, of which, indeed, they would become the principal and most effective fighting units. At present, the most formidable ship in the Greek navy is the "Giorgios Azeroff," of 9,956 tons, carrying four 9.2-inch and eight 7.5-inch rifles, with twenty four smaller guns. She did very effective work during the Balkan war, and her speed of 24 knots enabled her to attack when she pleased.

It is interesting to note that the powerful dreadnought recently purchased by Turkey is to be met by a Greek battle-cruiser, now under construction at Stettin, Germany, which will carry eight 14-inch and twelve 6-inch guns. But she will not be ready for some time to come, at least a year or two. Hence the advantage to the Greeks of the immediate possession of two such heavily armored ships as the "Idaho" and "Mississippi."

The Promise of Small High-speed Motors

ALTHOUGH *it is still a little early to prognosticate* with strict accuracy the multitudinous detail changes that will make their presence seen and felt in the new crop of automobiles that now are being started on their way through the great factories of the land, straws show which way the wind blows, and there is at least one feature that is practically certain to be very prominent. That feature is the small—or comparatively small—high-speed, high-efficiency four-cylinder motor.

During the past year we have seen the six-cylinder motor, and particularly the small six-cylinder motor, with a bore and stroke of about 3½ by 5 to 5½ inches, climb to great popularity; but now the pendulum seems to be swinging backward, and the small four-cylinder motor bids fair to step out into greater popularity than it ever attained before. Already a number of makers have announced 1915 cars that incorporate motors of this kind, and it is known that several makers, whose past year's activities have been devoted to exploiting small sixes, have practically ready for the market small *four-cylinder cars*, which will be released immediately the demand for sixes gives indication of dropping off.

For one thing, the notable success of a four-cylinder motor in the recent 500-mile race on the Indianapolis Speedway has given both the public and the designers food for thought. This motor, with but 183 cubic inches piston displacement, propelled its car at an average rate of 80.99 miles an hour; the car finished only seven minutes behind the winner, whose motor had 380 cubic inches piston displacement; it handily beat cars with displacements up to 450 cubic inches, which was the limit. But what is far more important, it kept on going—it demonstrated its reliability.

In demonstrating its reliability and its power, this tiny motor brought very forcibly to light the great truth in all engineering matters, that it is efficiency that counts. Efficiency means light weight, reduced friction, and above everything else, lowered operating cost. This is what the average motor-car owner desires. The cost of fuel already is high, in some places it is almost prohibitive. What we must have is high-efficiency automobile motors, and that is what we are going to get.

A few years ago speeds above 1,200 revolutions a minute were regarded as excessive, impracticable almost; yet now there are any number of foreign motors that operate normally at speeds up to 2,000 revolutions a minute. The answer is to be found in bettered workmanship and better materials. Practically all of the attention of foreign designers now is turning toward the production of small, high-speed, high-efficiency motors; they will have none of the big American motors, which are heavy and inefficient, and for that reason expensive to operate.

Only now is this foreign tendency toward high-speed, high-efficiency motors being felt on this side of the Atlantic. Already the practice has made inroads, it is coming slowly, and before long it will come with a rush.

The lightening of reciprocating parts, the reduction of internal friction to the minimum, the perfection of carbureting devices, and a general overhauling of the valve gearing and particularly of the valve timing, all are factors which are contributing to the success of the small high-speed, high-efficiency four-cylinder motor. These engineering problems are being solved slowly by the American designer, but progress undoubtedly is being made.

There will always be a market for the six-cylinder motor-car; there is no doubt of that. But has not the small six-cylinder motor been offered—or rather forced on—the public as an excuse for the lack of perfection of small four-cylinder motors?

To get the power we must have either large cylinders or high speed; we do not require both—not even in racing, as the lesson of that 183-inch motor points. Or, we must have a greater number of cylinders. Smoothness of operation may be left out of the question, temporarily, for the high-speed four-cylinder motor gives for ordinary purposes the continuity of torque that is given by a *six-cylinder motor operating at lower speed*.

So, as the cost of fuel remains high, large cylinders steadily are being relegated to the background, and designers are falling back on greater speed. And this is as it should be, for in lighter engines operating at higher speed we find greater efficiency, and that is what everyone most desires.

That the forthcoming year will see a very marked increase in the popularity of the small high-speed motor of the type under discussion there can be no doubt. It is only to be regretted that someone did not take the cue from our foreign brothers a long time ago.

Physical Law in Economics

AN economic system resembles in certain respects a physical system in a state of strain. Such a system represents a fund of potential energy, since the strains tend to become annulled by readjustment of the matter and energy in the system. Thus, for example, if we seize the center of an elastic band stretched between two supports, and pull it toward one end, a state of strain is created such that upon releasing the hold upon the displaced center, the latter returns to its original position. A point which should be noted is that in such case energy is so redistributed that it passes from regions of *greater* tension to regions of *lesser* tension.

Somewhat similar conditions prevail in an economic system. A number of "owners" possess various commodities to which they attach varying value, varying "tension." They exchange portions of their property until each has such *an assortment of property* as best satisfies his desires. In each case *property* passes from a point where *less* value is attached to it to a point where *greater* value is attached to it. At first sight this may appear to be just the opposite of the conditions observed above, relative to the readjustment of energy. But a closer inspection shows that the analogy holds good. For, as in the case of the elastic we had to consider the passage of *energy* from one half of the elastic to the other, and not the passage of *matter* (which takes place in the opposite direction in this case), so in the present instance we must think, not of the passage of *matter* from one owner to the other, but of the changes in the *energy* of the system. To make this clear consider a simple and somewhat extreme case. Suppose that *A* possesses such a large quantity of some commodity, bread we will say, that he can spare several loaves without feeling any appreciable loss. Let *B*, on the other hand, be nearly starving. In these circumstances it will require but little provocation to induce *A* to part with a loaf and pass it on to *B*. In this case, plainly, *matter* has passed from a point where a low value was attached to it, to a point where it is highly valued. But what are the conditions as regards *energy?*

B was near starvation, and willing to do practically anything within his power to obtain the bread. He was a source of available energy. *A*, on the other hand, was rather indifferent as to his possession of two or three loaves of bread more or less. He was not nearly as ready a source of energy as *B*. After the passage of the bread has been effected, *A*, having now less bread, is somewhat more susceptible to persuasion to do work to obtain bread, while *B* is less so, now that his hunger is satisfied, than he was before. We see, then, that potential energy may, indeed, be said, in this case, to have passed from *B* to *A*, from the point where *greater* value was attached to the commodity to that at which *less* value (tension) was attached to it.

The application of laws of energetics to the field of economics has been foreshadowed occasionally by such writers as Helm, but it cannot be said that the subject is, as yet, at all fully worked out. There seems reason to expect that the future may bring important developments in this direction.

Antivivisection Literature

WE have had occasion in the past to refer to some of the illogical and vicious practices of antivivisectionists. Unfortunately many who read the distorted accounts and misrepresentations emanating from these misguided persons have not the means of distinguishing the truth from falsehood. We have in mind an article which recently appeared in a popular magazine of wide circulation, and which showed pictures of animals seemingly undergoing torture by the applications of various gags and other instruments. *Such pictures are greatly misleading. In the first place*, most of the instruments shown are used only in conjunction with an anesthetic, and secondly, the appearance of ferocity of the gags, for example, is entirely spurious. Such gags are used merely to keep the mouth of the patient open where circumstances demand it, and are in no wise painful, even if no anæsthetic were used. Dr. Keen, in a paper entitled "The Influence of Antivivisection on Character," shows a picture of his little granddaughter photographed with such a gag in her mouth. The child, so far from resenting the process, looked upon the proceeding of being photographed with her mouth wide open as an amusing prank.

It is almost incredible to what lengths of falsehood and suppression of the truth antivivisectionists will go. The impression is persistently conveyed that vivisection is commonly practised without anesthetics. As a matter of fact, even if the operators were as inhuman as antivivisectionists seek to paint them, the use of anesthetics would be imperative in the great majority of cases, because the struggles of a suffering animal would make delicate operations absolutely impossible, to say nothing of the danger of injury to the operator.

It is to be feared that much harm has been done by the grossly misleading publications emanating from antivivisectionist quarters, and we take pleasure in bringing before our readers, in this week's issue of SUPPLEMENT, an exposure from the pen of Dr. Keen, of some of the wickedly deceitful methods employed by these foes of scientific and humanitarian progress.

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[illegible] in the [illegible]. It [illegible] to call [illegible]. In order to avoid the tedious delay, an electric [illegible] will probably be installed before the next [illegible] in December. It is estimated that it will cost $20,000 to establish the system.

Electricity and Food.—At the recent session of the National Electric Light Association, in Philadelphia, Mr. T. C. Martin gave an interesting report on the electrical stimulation and plant growth. He announced that vegetables such as radishes and lettuce, when subjected to electrical treatment, had shown a 75 per cent increase in growth over untreated vegetables. Evidently electricity is destined to play an important part in the production of our food.

Electricity from Coal.—According to press reports, Thomas A. Edison is now engaged with the problem of producing electricity directly from coal, and declares that it will be accomplished some day. If Edison succeeds in solving this problem, it will be without doubt his greatest contribution to the good of man. It will mean a great economy in coal consumption if he finds a way of converting all or nearly all the stored energy of coal into electricity. Others have tried to do this but so far have succeeded in converting only a small proportion of the energy.

Wireless in the South Orkneys.—According to the *Geographical Journal*, there is now wireless telegraphic service from the South Orkneys, through the South Shetlands, to the Falkland Islands, and thence to the rest of the world. The South Orkneys, on the verge of the Antarctic, are the site of what has hitherto been the most isolated meteorological station in the world, an important outpost of the Argentine meteorological service. The linking of this station with the world by wireless will be as notable an event as was the recent inauguration of daily wireless weather reports from Spitzbergen, in the Arctic.

Recent Advances in Radio-Telephony.—A great deal of activity is now being displayed in the field of radio-telephony. Many experimenters are reporting progress. In France, Com. Victor Colin and Lieut. Maurice Jeance have transmitted speech over a distance of 150 miles. It will be recalled that these two inventors held long distance wireless conversations five years ago. Mr. William Marconi expects soon to establish wireless telephone communication between his office and his country house, a distance of 67 miles. According to press accounts, Marconi has succeeded in talking with Berlin, which is 600 miles away. This, if true, is startling indeed. However, it will be recalled that, some time ago, press dispatches stated that Marconi had transmitted speech over 1,000 miles. Later it appeared that the communications referred to were in the form of dot and dash signals instead of speech.

Wireless Weather Forecasts for Great Lakes.—A daily weather bulletin for the Great Lakes is now being sent out from the radio station at Radio, Va., according to an agreement just arrived at between the United States Weather Bureau and the United States Naval Radio Service. This bulletin is sent out in two parts. The first consists of code letters and figures describing the weather conditions actually prevailing at 8 P. M. that day at various points along the Great Lakes. The second part of the bulletin is a special forecast of the winds that will probably be encountered on the Lakes. This is distributed to shipmasters on the Great Lakes by the Naval Radio Service during the season of Lake navigation—usually from about April 15th to December 10th—in the same way that weather conditions for the North Atlantic Ocean and the Gulf of Mexico are sent out. The latter service was begun in July of last year. It proved popular, and the Weather Bureau was encouraged to extend the service to the Great Lakes.

Resistanceless Conductors, Hence Permanent Electromagnets?—For many years the laboratory of Prof. Kammerlingh Onnes at Leyden has been the center from which some of the most important advances in low temperature research have been announced. It will be remembered that the Dutch physicist was the first to liquefy helium, the most refractory of all known gases, and that in the course of these experiments the lowest temperature on record, within a degree or so of absolute zero, was obtained. Of late, attention has been centered on the remarkable influence of temperature on the electrical resistance of metals. This resistance is found to become practically zero before the absolute zero of temperature is reached. Recent newspaper accounts state in somewhat vague terms that remarkable new developments have followed in the train of this work on the conduction of electricity at low temperatures. The question arises, what happens to an electric current once started in a conductor of zero resistance? Its energy is not dissipated as heat, since the ohmic effect is non-existent. Does the current continue to flow indefinitely? If so, a closed loop carrying a current would function as a permanent electromagnet. It is rumored that something of this kind has been observed. We shall await further news with interest.

Science

A Mount Rose Snow Sampler and Weigher, designed at the Mount Rose Observatory, has recently been ordered by Dr. A. de Quervain, Director of the Meteorological Service of Switzerland, for the use of the Swiss Gletscher-Kommission in the Alps. The sampler is to be 20 feet long and made in sections of 5 feet to facilitate being carried to the more inaccessible portions of the mountains. During the present season depths of 180 to 260 inches have been reached on several occasions. The density of the snow at these depths has been ordinarily 46 per cent, but the United States Weather Bureau, which has placed one of the samplers in Nevada, reports densities as high as 76.3 per cent.

An Insect Menagerie.—What Prof. Habitte calls his insect menagerie is installed at one of the laboratories of the Jardin des Plantes establishment, and he now has upward of fifty well-arranged boxes or cages where he observes insect life. He thinks that this should be enlarged into an "insectarian," or extensive menagerie, to which the public should be admitted. This is already done in some countries and their usefulness is recognized. No great expense is needed, all that is required being a hall with large tables on which the insect cages are placed in good view, with glass or wire-gauze covers. The insect world is of greater interest than may perhaps be imagined, and no doubt such an enterprise would be much appreciated by the public.

Animals that Never Drink.—It would seem that water is so indispensable to life that no animals could exist without drinking. Nevertheless, Dr. Blanford asserts that the antelopes which live in the sand desert between the salt lake Chilka and the sea never drink. This has been doubted by physiologists, who deny that existence is possible in such conditions, but confirmatory evidence is now adduced by Dr. Drake-Brockman. It appears that since 1910 a troupe of gazelles have lived in the small island Saad-ud-Din on the side of Somaliland, where there is no source of water and where the annual rainfall is less than three inches, so that these gazelles cannot obtain water except after very rare showers. The vegetation is very poor and they cannot supplement the lack of water during the dry season by consuming roots and bulbous plants rich in liquid.

"Lithia Water."—A signal illustration of the importance of the Food and Drugs Act is reported in a recent circular from the office of the Solicitor of the Department of Agriculture. In a case brought by the Government to condemn a consignment of alleged lithia water, offered as a remedy for various serious ailments, it was proved that the water in question contained lithium only in the proportion of about one grain in 10,000 gallons. As the average dose of this remedy as a uric acid solvent is from 5 to 7½ grains three times a day, it would be necessary for a person to drink from 150,000 to 225,000 gallons of the water a day in order to obtain a therapeutic dose. It was also shown that ordinary Potomac River water contains five times as much lithium as this so-called lithia water.

"Tango Foot."—Housemaid's knee, miner's elbow and similar ailments have now a formidable rival in "tango foot." In a recent number of the *Medical Record*, Dr. Gustav F. Boehme, Jr., states that he has recently been consulted by a number of dancers who complained of "pain in the front of the foot." In every instance, he found the same symptom-complex, and on investigation, discovered the cause constant—the modern dance. Says the doctor: "The latter day dances, especially the tango and the maxixe, and to some extent the complicated figures of the hesitation waltz, call for great flexibility of the ankle, with much movement at this point throughout the various intricate steps. The more common movements are those of extension, flexion, and adduction of the foot. The resultant is a constant strain on the extensor muscles of the foot, viz., the tibialis anticus, the extensor longus digitorum, and the extensor proprius hallucis, which in turn produces a tenosynovitis in this muscle group. The commonest tendon involved is that of the tibialis anticus.

The Kara Sea Route to Siberia is nearly always practicable during at least the months of August and September, according to E. Lesshaft, who has published in *Annalen der Hydrographie* a painstaking discussion of the ice conditions in that sea, as reported by vessels during the last forty-odd years. It has happened only once or twice that the sea has been entirely filled with drift ice during the months named; there is normally a large area of open water, but its location varies from year to year. In order that the route may be used, it is necessary for mariners to know in advance only which portion of the sea is open, in order that they may choose the appropriate entrance and steer the most favorable course. The distribution of ice depends upon that of barometric pressure, which can be determined by observations in Nova Zembla and at the mouth of the Obi River, and in both places meteorological stations already exist. As soon as these stations are connected with the world by telegraph, the important problem of using the Kara Sea as a highway to Siberia during a limited period each year will be solved, according to Herr Lesshaft.

Automobile

Cyclecar for Land and Water.—Amphibious cars are not new, of course, but lately one has been brought out in England which appears to be quite successful. It is a sort of combination cyclecar and boat. It is powered with a 4½ horse-power single-cylinder water-cooled motor which drives the vehicle while on land through a chain and two-speed gear set. There is a clutch for changing the drive from the rear wheel to a tail shaft upon which the propeller is mounted. The body, of course, is a boat hull. While the single rear-wheel drive is not ideal for helping the vehicle out of the water and up banks, the possibility of this combination has been demonstrated.

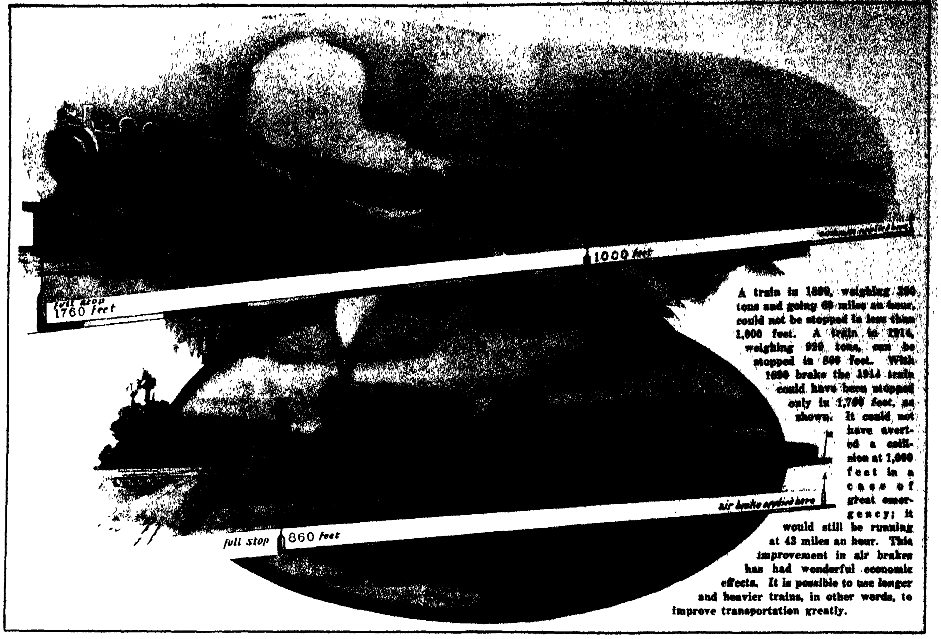
An Improvement in Air Cooling.—A British engineer has been quite successful in increasing the heat radiation of an air-cooled motor by the simple expedient of attaching to the existing iron fins a number of aluminium fins. Aside from increasing the radiating surface, the aluminium is a much more efficient radiating medium than is the iron. The extra fins are merely clamped to the existing iron ones, the only requisite being that a good contact is obtained. In a bench test in which a four-cylinder motor was raced for a considerable time, the radiating fins could at all times be held in the bare hands. Their temperature does not go higher than about 15 degrees above the temperature of the surrounding atmosphere

A Russian Automobile Contest.—The Russian event for automobiles, known as the Czar's Cup, organized by the Imperial Automobile Club, will be held during the month of August. The route is laid out from Moscow, Rostoff, Tiflis, Kherson, to Odessa. Cars admitted to the race must be of standard types published in catalogues at least six months before the date of the event, but any size of motor can be used. Standard four-place car body is to be provided, and the cars are to carry at least two persons, including driver. There will also be held three speed tests on this occasion, one at Rostoff and another at Odessa upon one kilometer length on level grade, and a third at Tiflis on up-grade for several miles length.

A Million Hides for Automobile Upholstery.—As an indication of the tremendous size of the automobile industry, it is interesting to note that in one year approximately 1,000,000 hides are used for upholstery purposes. The ordinary roadster body requires little more than two complete hides, and the touring body about three hides. The average per car therefore is 2½ hides. The average area per hide is about 50 square feet, so that 50,000,000 square feet of leather is used. From the time the hide is stripped from the animal, it requires from 10 weeks to 6 months completely to prepare it for use, the time varying with the quality of the leather. Each hide is split into four grades which are known as hand buffs, machine buffs, deep buffs and splits. The hand buffs are the best and are the part nearest the hair. This is the quality that is most used in the best motor car factories.

Making Bodies with Wood Cement.—Apropos of the suggestion made in this column some time ago that motorcar bodies might with profit be made of *papier maché*, it is interesting to note that a firm of French builders recently has perfected a method of using what is styled wood cement for this purpose, apparently with considerable success. In using the material, the exact composition of which is kept secret, the body is built of a light framework over which is stretched wire netting. The wood cement is then literally plastered on with a trowel. It dries quite hard in twenty-four hours, after which it can be planed like wood and is capable of taking a very high finish. The weight of the finished body is approximately the same as the weight of an ordinary wooden one. One valuable feature of the construction is that repairs are very easily made. In case of breaks caused by collision, etc., it is necessary merely to plaster up the hole and refinish the body. The material does not chip nor disintegrate, is impervious to water, heat or cold, and is practically incombustible.

A Dozen Lamps in Place of Four.—A British accessory manufacturer has attacked the automobile illumination problem in a brand-new manner. Instead of using four lamps, two of them high-power for touring and two much smaller for city driving, he provides no less than twelve small lamps, which are arranged in a row in the filler board between the wind shield and the top of the engine hood. During the time the lamps are not in use they are completely covered by a sliding shutter. For city driving only the two outside lamps are lighted. Where more light is required more lamps are lighted, and when the maximum illumination of the road is necessary, all of them are turned on. The most important feature of the arrangement, however, is that the angle of the group of lamps can be varied at the will of the driver so that any part of the road can be illuminated, sign posts can be shown up, or, on occasion, the reflectors can be shifted so that the light is turned down onto the engine for repairs at night. The lamps are shifted by a simple worm and gearing which is operated by a small hand-wheel placed upon the dash of the car. Another advantage is that the row of lamps does not mar the outward appearance of the car as do the ordinary lamps.



A train in 1890, weighing 280 tons and going 60 miles an hour, could not be stopped in less than 1,000 feet. A train in 1914, weighing 920 tons, can be stopped in 860 feet. With 1890 brake the 1914 train could have been stopped only in 1,760 feet, as shown. It could not have averted a collision at 1,000 feet in a case of great emergency; it would still be running at 43 miles an hour. This improvement in air brakes has had wonderful economic effects. It is possible to use longer and heavier trains, in other words, to improve transportation greatly.

Forty-five Years of Air-brake Evolution

By A. L. Humphrey

Vice-President and General Manager of the Westinghouse Air-Brake Company; Former Superintendent of Motive Power of Chicago & Alton and Other Railroads

FORTY-FIVE years elapsed between the first trial of the air brake and the death of George Westinghouse, an event which has taken, untimely, a discoverer of momentous things and bereft his associates of an inspiring leader. Most people know that the celebrated inventor was throughout that half century so greedy for work that somebody said "he has put a brake on every train but he cannot put a brake on himself"; but the air brake does not figure in the common thought as the basis of any of these later triumphs It is looked upon rather as having sprung from his brain, perfect and complete. To those of us who had the rare fortune in any part of that period to be his colleagues or contemporaries in the manufacture and use of railway appliances this seems a grotesque and romantic notion; for the introduction of the air brake was only its birth. It has had a strenuous infancy, an eventful youth and a recent past of wonderful development. Maturity it cannot reach until transportation by rail ceases to progress The quick action triple valve, brought out by Westinghouse in 1887, and the high-speed feature of the passenger train brake, added in 1894, have rendered a continuous service which in length of time, universality of application and degree of excellence is unapproached by any other mechanical device in common use at the present time upon railways The past ten years have seen further notable advances.

A train in 1890, weighing 280 tons and going sixty miles an hour, had an energy of 33,000 foot-tons. The best air brake of that day, working to the top of its strength, could not stop that train in less than 1,000 feet. A train in 1914, weighing 920 tons and going sixty miles an hour, had an energy of 111,000 foot-tons, almost four times as much as what had to be dissipated in stopping the train of 1890 With the 1890 brake the 1914 train could have been stopped in perhaps 1,760 feet. As it passed the 1,000-foot mark it would still have a collision energy of 48,000 foot-tons (one and one-half times what the 1890 train had before the brake was applied), and it would still have 760 feet to run. That 1914 train with a 1914 brake can be stopped in 860 feet. At that point the same train with an 1890 brake would still be running forty-three miles an hour, with a collision energy of 57,000 foot-tons, or about twice that contained in the 1890 train at the beginning of the stop. It is not so much that the 1914 brake is bigger, as that it is different, and the laboratory has toiled through forty-five years to produce this doubling of the air brake's efficiency.

Safety Is Not the Sole Benefit of the Air Brake.

Another impression which many people have is that safety is the sole benefit from the air brake. That phase is a commonplace When you read that an engineer did not stop you know that he probably could have stopped, since he had the means. To those who make or use it—to the railway manager racking his brain for ways to curtail controllable expense in order to meet other expense which is beyond control, the air brake has been and is one of the most effective of economizers. Think what it does The train running at speed can be quickly stopped. What follows? That you dare run it at speed! And how does speed effect economy? By increasing the revenue which can be earned in a day by the crew; by the locomotive, which can haul a longer and heavier train; by the car, which will hold more tons; by the trackage, which can accommodate more trains a day; by the traffic solicitor, who can bring more freight and passengers if service is quicker. It is not alone that longer and heavier trains and more of them can be operated at speed, because the air brake will stop them when there is danger. Countless station stops, slow-downs and applications while descending grades are made to one emergency stop. The time saved in such routine operations and the larger use of plant, especially at junctions and terminals, due to quick stopping, without damage to cars or cargo, is one of the most important results accomplished in the whole brilliant history of organized railway endeavor for economical and efficient operation.

The commonest measure of economical railway operation is the average train-mile load. For the United States this average has risen from 175 tons in 1890 to 409 tons in 1912. Is it surprising that the railways have given and are more and more giving the most eager and systematic co-operation to the manufacturer in the development of air-brake improvements?

The growth of the brake to carry the modern burden has steadily progressed. Higher speeds, heavier vehicles, longer and heavier trains and their greater frequency increased the amount of work required of the stopping device. The effort consumed in stopping a given train going twenty miles an hour is four times that required at ten miles per hour. The brake shoe, which performs its function through friction against the wheel, is at a disadvantage, which is aggravated as the amount of work required within a given distance increases. A further loss occurs as the greater force is exerted through the foundation brake rigging and because of the longer time taken to obtain full braking power with large cylinders and larger trains. With longer trains, also, and their greater frequency, and with an increasing number of parallel tracks (each liable to accidents which pile up obstacles on adjoining tracks), an increase in the volume of air used interferes with the prompt and uniform response of the brakes to the manipulation of the valve, both when applying and releasing. This makes recharging more difficult and demands a larger available supply of compressed air. Another tendency which was manifested with enlarging train units was that the time elapsing between the action of the brakes at the head end and at the rear end of the train caused a bunching or stretching out of the slack between cars, and this interfered with its smooth handling. The increased risk, moreover, introduced with a greater number of parallel tracks and greater frequency of trains made mandatory that full energy of braking power be available at any time.

To enable the brake mechanism to perform this augmented and more complex task, the most obvious and essential step was to insure the best of use of the device as it stood. A poor brake well maintained and operated in the best possible manner will give better service than the best brake if neglected or carelessly handled. This meant systematic instruction of those responsible for handling of trains in service and for the care, inspection and maintenance of the brake mechanism. Both railroads and manufacturers developed trained corps of experts and special methods and apparatus for testing and repairing and provided technical literature and instruction paraphernalia, including elaborately equipped instruction cars and rooms. By organized efforts along these lines increasingly

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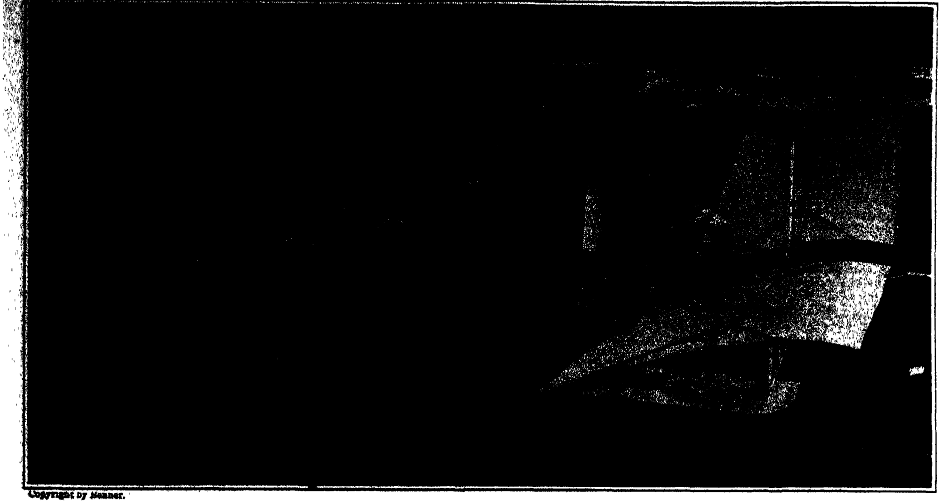
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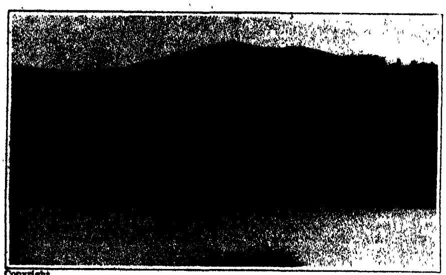
The Langley "aerodrome" with the pontoons provided by Mr. Curtiss.

The Langley Aeroplane Construction and Control Mechanism

By Our Staff Correspondent at Hammondsport

THE brief flight of the Langley aeroplane recorded in these columns has since been several times repeated, and always with the same steadiness on the water and in the air. Efforts are now to be made to increase the thrust to meet the greatly augmented weight and resistance due to the added floats and trussing which unites them with the aeroplane proper. The present weight with Mr. Curtiss as pilot is 1,170 pounds; the old weight with Manly as pilot was 830 pounds. The increase of weight is, therefore, 40 per cent; the increase of flying resistance is of a like order, possibly greater, due to the augmented drift on the wings, and the head resistance of the floats and framing. It is believed that careful adjustment and some further trials will enable the engine to bear this excessive load in longer flight. If the launching had been made from ice, with light skates as the only added weight, a prolonged flight could have been made on the first trial, since there would have been an excess lift of approximately 300 pounds, and, of course, much less head resistance. Or if a slightly stronger engine were substituted, no careful adjustment would be required to achieve long flights.

The Langley aeroplane may be viewed either as a type or as an individual machine. As a type it seems to have been invented by D. S. Brown, and exhibited as a kite, in 1873, before the Aeronautical Society of Great Britain. The tandem arrangement of supporting surfaces also appeared in Hargrave's kites, and in Kress' aeroplane of 1893 and earlier; also in Langley's steam model flier of 1896; Montgomery's great glider of 1905, Blériot's first successful flier, patterned after Langley's large machine, also in some present-day fliers, notably Colliex's huge tandem biplane flying-boat, which is reported to have a useful load of 4,000 pounds, or a range of 1,000 miles, and has recently lifted with ease from the Seine Langley's successful steam models and gasoline models were of both monoplane and biplane types.

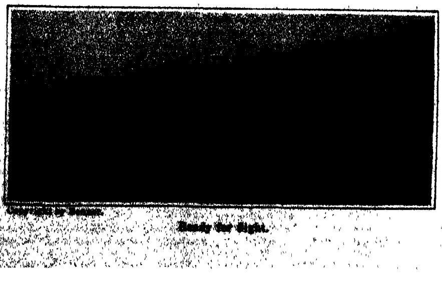

Copyright by Benner. The Langley "aerodrome" rising from the water.

Copyright by Benner.

Floating the machine.

The Langley tandem aeroplanes are unique and highly original throughout. The large machine now at Hammondsport, which antedates its quarter-scale model, flown successfully above the Potomac in August, 1903, is a marvel of design and workmanship. It is the first aeroplane in history provided with an internal combustion motor; the first capable of carrying a man in sustained flight, the first man-flier with good enough inherent stability to take care of itself in moderate weather.

Langley's large "aerodrome"[1] is a tandem monoplane driven by twin propellers just aft the front planes. As seen from a distance, it shows four great dragon-fly wings and a long, double tail, all mounted on a long open steel frame, with a steering rudder beneath and abaft the center. The propellers on either side are connected by bevel gears to the engine ensconced in the frame just aft the fore wings. Posts for the numerous stay wires just above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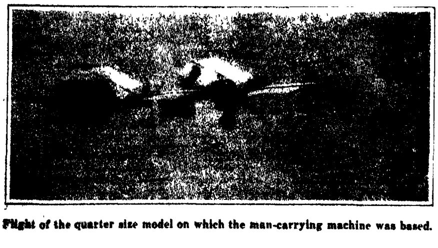
Ready for flight.


Flight of the quarter size model on which the man-carrying machine was based.

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[1] The term "aerodrome" was used by Langley to connote an "air runner" or any kind of heavier-than air flying machine. It is now generally applied to an assemblage of buildings and grounds used for flying

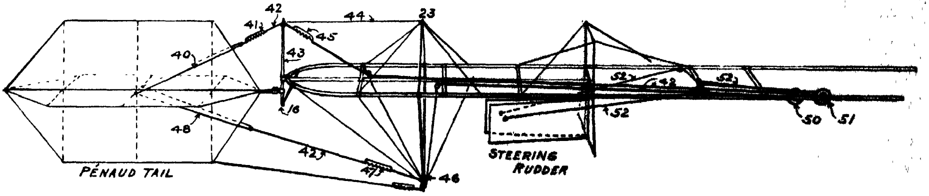
and below the frame at the wing spars, and a bowsprit protrudes from the prow. No running gear was provided, as the flier was originally to be shot from a catapult above a houseboat, and to land in the water after its voyage. The recently added pontoons, two flat ones in front and a cylindrical one at the rear, show conspicuously in the general view, especially when well out of the water.

The whole machine weighed originally 830 pounds, including the pilot; spread 1,040 square feet of wing surface, measured 52 feet from tip to tip, and 52 feet from the point of its bowsprit to the end of its tail; soared at 33 feet a second, and at a 10-degree angle of flight. The wings measured each 11 by 44 feet, arched one in eighteen at one fourth the distance from their front edge, and were covered only on their upper side. The double rudder, at the extreme rear, measured 95 square feet each in its horizontal and in its vertical surface. The vertical steering rudder measured about one square yard, and opened at the rear like a weather vane to give more grip at small angles.

The propulsion plant was most carefully designed and constructed. The gasoline engine weighed, without accessories, 125 pounds, and developed 52.4 horse-power in actual test at 930 revolutions a minute. With all accessories, including radiator, cooling water, pumps, tanks, carbureter, spark-coil, and battery, it weighed 200 pounds, or just 3.81 pounds per horse-power, a fine showing for the opening of the twentieth century. It could run ten hours continuously under full load, consuming about one pound of gasoline per horse-power per hour. Its five cylinders, arranged radially round a single crank-shaft, were made of steel lined with cast iron, and measured 5 inches in diameter by 5½ inches in stroke. By means of bevel gears it drove the twin screws, supported on steel tube brackets on either side of the steel tube frame, at 700 revolutions per minute, giving a thrust of 480 pounds, the screws being very nearly true helices, 8 feet in diameter, of unit pitch ratio, and 30 degrees width of blade, carefully formed of three radial arms covered with canvas.

Good inherent stability and fair manual control characterized the original machine. The lines of lift, propeller thrust and forward resistance passed through its center of mass, thus providing for projectile and gravitational equilibrium. The wings were set at a fair dihedral angle to give lateral stability. The rear rudder in level flight met the air at a negative angle of incidence, so as to check any serious diving; it was elastically connected to the main frame struts to dampen pitching, it was hinged to move up and down, but prevented by stays from moving sidewise. The pilot, seated in a little canoe under the fore wings, could steer up and down by working the big tail with a hand wheel, and steer right and left by working the wind vane rudder with another hand wheel. He had no lateral rudder, ailerons, or warping wing tips to control the lateral poise; but he could shift his weight several feet to right and left and fore and aft. Altogether the machine was quite as manageable as the famous Antoinette monoplane and Voisin biplane, which, in 1909 and subsequently, voyaged scores of miles in stiff winds, and achieved world records and prizes at international meets.

From what precedes it may be judged that the large Langley aerodrome of 1903 was capable, and is still capable, of sustained free flight with a man. It was intended only as an experimental aeroplane, to prove the feasibility of human flight, then to be provided with landing gear and otherwise better adapted to practical uses. But for the accidents in launching this machine, in September and December, 1903, Langley would undoubtedly have inaugurated the era of successful human flight, if the present day flying can be called successful in a broad sense. As it is, he has had no superior in the development of aviation; for he made contributions to the fundamental science of aerodynamics; made numerous models propelled, first by rudder, then by steam, then by gasoline; and finally produced a full scale machine that can carry a man as it was designed to do. When finally the aeroplane shall become an important agency in the civil and serious business of the world, who will be called its inventor? Langley's work will, doubtless, rank level with the best that has yet been done in the world of aviation.



Stabilizing and steering mechanism of the Langley aerodrome.

To maintain equilibrium Langley relied mainly on the use of the Pénaud tail. The combined Pénaud tail and rudder controls the longitudinal equilibrium by movement in the vertical plane under the combined influence of its initial negative angle and the elasticity of its connection with the frame, the flight being kept as nearly as possible in a straight line, by the vertical surfaces of the tail. The tail swings up and down by reason of its pin connection with the vertical tube 16. The bridle 40, connected with the center of the tail on its upper side, passes upward, where it is connected with the spring 41, which in turn is connected with a single wire rope 42, passing over a pulley mounted on the top of the post 43, guyed to the upper side post by the wire 44. After passing over the pulley the wire rope 42 is connected with the spring 45, around the two ends of which it forms a loop, and from there it passes down to the plane of the main frame, and through suitable blocks to the aviator's control wheel 50, convenient to the right hand. The wire from this point passes through various pulley blocks toward the rear of the machine and through the pulley block 46 mounted on the side near the bottom of the rear lower guide post. At a short distance beyond this pulley it is connected with a weaker spring 47, the other end of which is connected by a second bridle 48, with the under side of the Pénaud tail. The control wheel can be automatically locked in any position in which it may be when the aviator removes his hand from it. For rising or descending the aviator can swing the Pénaud tail from its extreme upper position to its extreme lower position by a small motion of his hand. The control of the steering rudder is effected by a steering wheel 51, a continuous cord 52, passing from the steering wheel through suitable pulleys to either side of the steering rudder.

X-Ray Analysis of Crystals

By John W. N. Sullivan.

TWENTY-FIVE years ago Lord Rayleigh discovered that the brilliant coloration of crystals of chlorate of potash when white light falls on them is due to selective reflection. From all the rays of different wave-lengths which constitute white light the crystals select rays of certain wave-lengths, within very narrow limits, for reflection. This effect is due, as Lord Rayleigh showed, to the existence of regularly spaced twinning planes in the crystal parallel to the reflecting surface, and he illustrated the effect by reflecting a high-pitched note by a series of parallel muslin sheets stretched tight and evenly spaced.

At the present time, using X-rays instead of white light, investigations are being made on the actual arrangement of the atoms in various crystals, by observing the manner in which they reflect X-rays from their various faces.

A pencil of X-rays of uniform quality is reflected from a face of a crystal when, and only when, it meets that face at the proper angle of incidence. There is a certain relation connecting the wave-length of the X-radiation, the proper angle of incidence, and the spacing of the planes in which the atoms of the crystal are arranged, which planes are regularly spaced and parallel to the face of the crystal.

It is evident that by observing the correct angles of incidence for reflection at the various crystalline faces for the same pencil of X-rays, and deducing therefrom the different spacings of the atomic planes parallel to each face, we can, by analyzing these results, deduce the actual distribution of the atoms throughout the crystal, and even build models illustrating the atomic constitution.

For these experiments we require a homogeneous pencil of X-rays, and bulbs having rhodium or palladium antikathodes are very suitable, as they last well, their line spectra are very intense, and the wave-lengths are of convenient magnitude. The exactness of the reflection effect is such that the two constituents of the principal rhodium line, which is really double, are just separated by reflection at the cleavage face of the diamond.

A crystal is considered to be made up of groups of atoms. Each group is supposed to contain as few atoms as possible consistent with the requirement that the whole crystal may be built up by packing all these groups together, the groups in any one crystal being similar and similarly oriented.

If now we choose any point in a group as characteristic of that group, then by choosing corresponding points in every other group in the crystal we get an assemblage of points which indicates the relative position of any one group with respect to any other group in the crystal. The assemblage of points obtained in this way is known as a [illegible] mental importance in [illegible] a crystal.

The large class of crystals [illegible] are the simplest in construction [illegible] reference to their space lattices, [illegible] divisions.

In the first division, which is called the [illegible] representative points for each group are placed at the corners of a cube, the whole lattice consisting of a repetition of this arrangement in all directions in space. In the second division, the centered cubic division, there are representative points at the corners of a cube and at the center of the cube. The third division, known as the face centered cubic, is characterized by having its representative points at the corners of a cube and at the middle points of the faces. By building a model we see at once that the relative spacings of the planes in these three divisions are different, and this causes corresponding differences in the angles of reflection of some standard line, when using the X-ray method of analysis; so that these three types of lattice may be at once distinguished from one another.

We now come to a case of great importance. Sodium chloride and potassium chloride have long been known to be of similar construction, although until quite recently the precise nature of the construction has not been known. By using the X-ray method of analysis, however, we find that the sodium chloride crystal has the characteristics of the third class of lattice, and the potassium chloride crystal of the first type of lattice. In addition, it appears that the elementary group, or pattern, contains the same number of atoms in each case. Prof. Bragg explains these facts as follows: "Suppose that we place chlorine atoms at the corners of a cube and at the centers of the faces and sodium atoms at the middle points of the edges of the cube and at the cube center, and take this to represent the structure of sodium chloride. Potassium chloride may be derived from sodium chloride by replacing the chlorine atoms of the structure by potassium. Now, it appears from a number of mutually supporting indications that the contribution of an atom to the reflection effect depends on its atomic weight only. The atoms of potassium and chlorine are of very nearly the same weight, and can be looked on as equivalent. If this is done, the structure of potassium chloride is, in effect, the simple cubic. But there is a great difference between the weight of sodium and chlorine, and the face-centered arrangement of the chlorine atoms taken separately gives its character to the whole sodium chloride structure. All this agrees with experiment. But there is more. The presence of the sodium atoms among the chlorine, arranged, as a matter of fact, on a face-centered lattice of their own, modify the purely face-centered character of the spectra, and experiment shows that the modification is exactly such as theory predicts."

The simple crystals have been analyzed and the structure of many of the more important cubic crystals is known. The complex structure of the calcite series has been determined, and something has been discovered of the still more difficult structures of sulphur and quartz. In each of these cases we require to determine not only the lattice, but the arrangement of the atoms in the group which is represented by each point on the lattice.

Among cubic crystals, one of the most interesting is the diamond. The carbon atoms are arranged in a most beautifully symmetrical pattern, each being at the center of a regular tetrahedron composed of its four nearest neighbors. Rings of six carbon atoms form a predominating feature. Planes perpendicular to a cube diagonal are arranged in a curious way, the spacings and spacings, large and small, in the direction of [illegible].

[illegible] has exactly the same structure as the diamond, [illegible] planes of the [illegible] last mentioned [illegible], zinc blende [illegible] and sulphur [illegible].

Iron pyrites has a rather more complicated structure, which explains at once the curious disposition of the striations on its faces, while sulphur has eight interpenetrating lattices, quartz three of silicon and six of oxygen. In the last two cases the lattices are regularly spaced along the long axis, but not in other directions.

The atoms of a crystal are, of course, in movement to an extent which depends upon the thermal state of the crystal, the motion increasing as the temperature rises. According to theory, this must tend to destroy the intensity of the spectra, particularly those of a higher order, a deduction which is confirmed by experiment. The angles of reflection diminish and the spacings of the planes increase as the crystal expands by heat, which suggests a method for measuring the coefficients of expansion of crystals.

But, besides the light thrown upon the structure of crystals by the X-ray method of analysis, valuable information is afforded us respecting the X-rays themselves.

In the *Proceedings* of the Royal Society for last year Prof. Bragg has shown that by the reflected X-rays a method may be derived for the spectroscopic study of the X-rays.

Using an ionization method, he has measured the intensity of the rays reflected at certain angles by the crystalline faces, and showed that the distribution of these intensities gave evidence of a series of maxima and minima, which gives a first approximation to the distribution of energy in the spectrum considered as a function of the wave-length.

A Close Shave in the Air

WITH only a few flying machines in the world and the whole ocean of air to fly in, one would think a collision of aeroplanes to be next to impossible. And yet more than one of such accidents have occurred, and the results were, of course, disastrous. Certainly there would seem to be less excuse for an encounter in the three-dimensional space of the aeroplane's domain than in the two-dimensional planes of travel that land and sea vehicles must adhere to. The aerial pilot may leap over or dive under his adversary; and yet with no fixed lanes of travel it is evident that much confusion is liable to arise, particularly as flying machines are very fast and there is no system of signaling between them.

At the recent aviation meet at Heliopolis, a collision between two aeroplanes was so very narrowly averted as to send thrills of horror through the spectators. In this case the proximity of the aeroplanes was due to the fact that they were rounding a pylon and were trying to hug the course as closely as possible. There were three aviators in the air, Guillaux, Chevillard, and Olivier. Suddenly Guillaux was seen to approach Chevillard, and it looked as though he would surely strike the right wing of Chevillard's biplane as it was banking for the turn. By the barest margin the monoplane cleared the biplane, and the two aviators continued their flight, undaunted by their harrowing experience.

By rare good fortune one of the correspondents of *L'Illustration* happened to catch the two aeroplanes with his camera at the very moment when the collision seemed imminent. We have used this remarkable photograph, by courtesy of *L'Illustration*, for our cover illustration. It shows by what a small margin a serious accident was averted. It is the first photograph ever taken of an aerial encounter. In the distance may be seen the biplane of Olivier.

Scientific and Animated Gyrostats

AT the recent Conversazione of the Royal Society, Dr. J. G. Gray exhibited gyrostats with accessories and a series of what may be called "animated" gyrostats. These latter consist of gyrostatic acrobats, bicycle riders, and gyrostatic motor cars, both two-wheeled and four-wheeled. The models exhibit Dr. Gray's methods of endowing gyrostatic devices, mounted on moving bodies, with complete stability. The devices, so mounted, are available for directing and forcibly maneuvering the bodies. One of the two-wheeled cars is provided with a gyrostatic "chauffeur," which stabilizes the car and presides at the steering wheel. This car illustrates the action of directing and stabilizing apparatus for use on torpedoes, airships, and aeroplanes. A further form of two-wheeled car demonstrates methods of stabilizing and maneuvering an airship by means of forces derived from the gyrostats, which apply [illegible] to the moving body. Dr. Gray's [illegible] and motor cars can be steered by the wireless transmission of electrical waves.

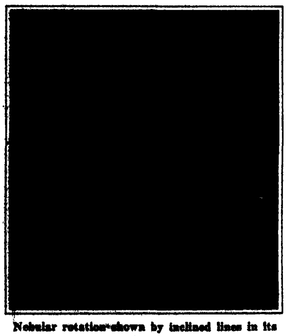
The Discovery of Nebular Rotation

By V. M. Slipher, Lowell Observatory

BEYOND the solar system the astronomer is concerned with two kinds of objects, stars and nebulæ. That these are related by some general process of evolution has long been thought. Laplace's celebrated nebular hypothesis is an attempt to outline how an extended nebula might evolve through contraction under the force of gravitation into a star like our sun and be surrounded by planets in consequence of the nebula's rotating during the process. This was, as he pointed out, speculative, but Sir William Herschel's epoch-making observations of nebulæ in various degrees of condensation led him to a like theory. Herschel found gradations in nebulæ from the most diffuse to those scarcely distinguishable from real stars.

During the last thirty years the spectroscope and the photographic plate have added vastly to our knowledge of both stars and nebulæ. And there have come to light so many hints of an evolutional process running through and connecting these bodies, that we are to-day using many descriptive terms which tentatively assume an orderly evolution. Finding this law is the problem that faces the astronomer to-day, and now, as in the days of Swedenborg, the geologist wants the answer, that he may the better know the earth's past and future.

In the investigation of the spectra of the celestial bodies we to-day use the spectrograph, a photographic spectroscope, which receives the light through a very narrow window or slit, adjusted into the focus of the telescope. After entering the slit the light passes through a lens to prepare it for the prism, which next receives it and passes it on, refracted and dispersed, into its component colors, to the camera. Here the light falls on a photographic plate. In the telescope, stars are always bright points of light, planets bright disks, nebulæ faint patches of various shapes and sizes. Thus if the telescope be directed on a star the spectrum will be a very thin band; if on Jupiter, a broad band, running through the colors from red to violet, but interrupted by the numerous spectral lines. It is these spectral lines—always different for different substances—that tell us of the presence of the chemical elements in the stars and nebulæ, and also of their motions; for, if approaching us, the lines are all shifted toward the violet end of the spectrum; if receding, toward the red, the amount of the shift telling how rapidly. A terrestrial spectrum is always photographed beside the celestial spectrum, to enable us to make all desirable comparisons and measures. On such a spectrum photograph of Jupiter, made with the slit on his polar diameter, the Jovian lines will cross the spectrum band at right angles, as do the comparison lines; but if the slit be placed on the equator of Jupiter, then his lines will be inclined in consequence of his diurnal rotation, which causes one edge of his disk to approach us and the other to recede. By measuring the inclination of the lines, the length of the planet's day can be deduced.



Nebular rotation shown by inclined lines in its spectrogram.

It was the application of this method, made at Flagstaff a few years ago, which showed the length of the day of Uranus, previously unknown, to be about ten and one half hours.

These methods, known for twenty years, have only recently been applied to the nebulæ. The reason for this delay in so studying the nebulæ with the spectrograph is doubtless due to the faintness of their spectra. The slit can receive light from only a thin line of the already faint nebular image, and the prism disperses it into a spectrum that is so faint as to require not only hours, but nights and even weeks, of exposure before the most rapid photographic plate will give a useful negative.

Spectrum photographs of an interesting nebula in the constellation of Virgo, catalogued as N. G. C. 4594, made with an especially efficient spectrograph attached to the 24-inch refracting telescope, show the nebular lines unmistakably inclined, and therefore prove the nebula to be rotating about an axis. This nebula may be seen in the accompanying illustration from a direct photograph made with the 40-inch reflecting telescope of this observatory by Mr. C. O. Lampland. The elongation of the nebula is east and west. The slit of the spectograph was placed over this long axis, which would show the axis of rotation to be nearly north and south. It doubtless rotates about the central condensation, from which it seems to extend into a more or less disk-like mass which appears spindle shaped, because we must look against its edge. If Laplace could have seen this nebula as it really is, he might have found in it a satisfactory illustration of his nebular hypothesis.

While it has long been thought that the nebulæ rotate, this actual observation of the rotation was almost as unexpected as the discovery that this and other similar nebulæ have enormously higher velocities than do the stars. The discovery of the rotation of this nebula has opened a new field for investigation, which can hardly fail to throw some light on the important subject of stellar and nebular evolution.

The American Radio Relay League

THE American Radio Relay League has been organized in Hartford from the Radio Club of Hartford, a group of wireless enthusiasts and experimenters. This league is intended to organize and link together the best amateur wireless stations in the United States and Canada. According to our information, there are some 300,000 of the amateur wireless telegraph stations in existence and actually receiving and transmitting messages at the present time. It only remains to link the best of these together in order to make it possible for an amateur in Maine to communicate with an amateur in California.

Already the league is transmitting from Hartford, Conn., to Buffalo, N. Y., through Northampton, Mass., and Westfield, N. J. Certain hours in the evening are prearranged, and these messages are relayed through by courtesy. With conditions favorable, a message is sent through to Buffalo, delivered, and the answer received back within the hour.

Up to the advent of wireless telegraphy, and its popular use by the lay public, the only way to transmit intelligence was by the assistance of the telegraph or telephone companies, or else the postal facilities of the Federal Government. The popular adoption of wireless telegraphy makes it possible for the private citizen to bridge distances without the aid of either the big corporations or the Government.

Amateur wireless operators are requested to communicate with the Radio Club of Hartford and secure blank forms, which, when filled out, are used for appointing the official relay stations.

The Wanamaker Transatlantic Machine

IT is announced that the Rodman Wanamaker transatlantic machine which Glenn H. Curtiss is building at Hammondsport will soon be ready for its first trials. It is stated that the machine is almost ready to be assembled. The motors were recently subjected to a 30 hour continuous run. There are two of them, each of 100 horse-power. Originally it was intended to use a single motor of 200 horse-power, but Lieut. Porte advised that two well-tried stock motors should be used instead of a single large experimental power plant. It is said that the Wanamaker machine is not as large as originally intended. Its length is only thirty feet.

The Current Supplement

IN this week's issue, No. 2007, of our SUPPLEMENT, Dr. F. H. Hatch gives a review of current theories of ore genesis.—The reduction gear and dynamometer of the United States steamship "Neptune" is described in detail.—S. Chapman writes on the number of stars and the light received from them. An important paper which should be read by all is Dr. W. W. Keen's "The Influence of Antivivisection on Character." A rapid system of water filtration on a large scale is described and illustrated.—J. Boyer contributes an article on pneumatic grain elevators.

Wright Flying Licenses

IT is announced that the owners of aeroplanes which infringe the Wright patents must pay a fee of $1,000 to the Wright Company and, in addition, $25 for each day or part of a day that the machine is operated or exhibited for profit or prize. The license expires on December 31st. Aviation meetings are by no means as popular as they were five years ago. It is not likely that professional aviators will therefore eagerly accept the Wright conditions.

Mistletoe thrives on the Western coasts to an extent not approached in the East. In many places this parasitic growth is responsible, directly or indirectly, for a considerable loss of timber.

The Super-dreadnought "Queen Elizabeth"

The First Battleship to Mount 15-inch Guns

By Oscar Parkes

THE battleship "Queen Elizabeth," and her sister ships, "Warspite," "Valiant," "Barham," and "Malaya," mark the commencement of a new era in British naval construction, being the first ships to carry the new 15-inch gun—a weapon which discharges a projectile of 1,950 pounds weight against the 1,400 pounds of the 14-inch and latest 13.5-inch guns In addition, they will be the first ships other than scouts and torpedo craft to be driven solely by oil-fuel, and with their speed of 25 knots—which is likely to be greatly exceeded on trial—will have the distinction of being the fastest battleships afloat

Although officially designated 'battleships," the "Queen Elizabeth" class are becoming looked upon as "battle-cruisers" from the fact that their speed is four knots in excess of the standard speed for line ships and obviously intended for overhauling the enemy's rear-guard and forcing an action—the generally accepted rôle of the battle-cruiser. In later ships a return has been made to the usual speed of 21 knots, the "Royal Sovereign" class which are now under construction having the same armament as the "Queen Elizabeth," but on something like 2,000 tons less displacement · the decrease being accounted for by the drop in speed, and the saving in machinery weight, engine room, and therefore dimensions

The adoption of the 15-inch gun is, of course, typical of the British policy, which is "superiority both in numbers and individual power." It would have been simpler to have met foreign ships armed with ten or more 14-inch guns by the construction of similar ships, but equality does not postulate annihilation, and this is what will probably be the fate of the "Queen Elizabeth's" opponents British gunnery experts do not, however, favor the placing of more than ten big guns in a ship, and even had the Admiralty been anxious to retain the very successful 13.5-inch gun which has appeared in the "Orion," "King George," and "Iron Duke" types, their reply to say the "Pennsylvania" would have been a ship with ten of these pieces—twelve or fourteen such guns would have been more than can be adequately controlled, according to British practice. Eight guns being the ideal group, it becomes obvious that the only way out of the difficulty of providing a better and more powerfully armed ship lay in increasing the caliber of the guns—hence the advent of the 15-inch and the probable early reappearance of the 16.25-inch gun when the smaller weapon becomes generally adopted elsewhere.

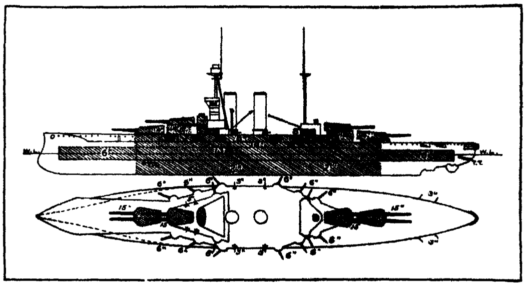
In appearance the new ships will be very much like the "Iron Duke" class, with the amidships turret suppressed and an extra mast aft, instead of the stump between the funnels, which is such an unsightly feature of these vessels. There is the usual pile of chart houses and bridges forward, the heavy tripod mast with a double-storied control-top, big funnels, and torpedo net defense. The big guns are in four 14-inch turrets along the center line, the third and fourth superfiring axially. In casemates in the superstructures and along the upper deck are spaced the sixteen 6-inch rapid-fire guns, while eight 3-inch anti-aero guns are distributed over the upper works, and four more are carried at the stern of the ship. There are five torpedo tubes (21-inch), two on each side and one in the stern, all below water.

The dimensions of the "Queen Elizabeth" are: Length, 650 feet over all; beam, 94 feet, and draught, 27½ feet, giving a displacement of 27,500 tons.

For water-line protection there is a 13½-inch belt extending from the base of the foremost turret to just short of the aftermost, with 6-inch continuations to within about 20 feet of the extremities. Above is a 10-inch strake along the lower deck side amidships with 8-inch over the battery, the gun positions in the superstructures being similarly protected. Amidships the hull is covered with thin armor—two or three inches, probably—down to the keel, and a most elaborate system of internal under-water protection reinforces this. The thickness of the armor decks and bulkheads is uncertain.

The great speed has only been attained by the substitution of oil fuel for coal, and a supply of 4,000 tons of this can be stored. With Parsons turbines generating 58,000 nominal horse-power and driving four screws, the designed speed is 25 knots.

Of the five ships, only the name ship and the "Warspite" have as yet been launched (March), and these two are due for completion in October; the remaining three should join the flag between Spring and Summer, 1915. At present afloat the only ships which can compare with them in fighting power are the "Texas" and "Oklahoma" classes, with the Japanese "Kongo," the Chilian "Al Latorre," and the Turkish "Rechadieh."



Outboard profile and deck plan of super-dreadnought "Queen Elizabeth," showing guns and armor plate.

Note under water protection against torpedoes

Psychophysical Tests for Falsehood

By Dr. Anton Rose

FALSEHOOD, when practised by an expert, is not easily detected by the most careful scrutiny of the liar's appearance and manner, but extraordinary and successful means for its detection have been developed from the study of experimental psychology. The principal psychophysical factors employed in this method are the character and rapidity of the mental process known as association of ideas. The word "horse," for example, may suggest anything related to horses—a stable, a familiar breed, a characteristic color, such as bay or chestnut, a race track, etc.

In criminal jurisprudence this fact is utilised by uttering a word and requiring the suspected person to say, instantly, what the word suggests to him. The test is repeated with a great number of words, some of which, introduced in an apparently casual manner, bear directly on the crime and relate to facts which only the criminal knows. If the suspect is really guilty he is pretty sure to betray himself unconsciously. Even if he is cautious enough to modify the first response that occurs to him, he betrays himself by the slight delay thus caused, for the abnormally long interval between question and answer (which is measured to a fraction of a second) shows that he has taken time for consideration, at a point of danger.

A simpler and more objective test has recently been adopted. This test is based on the intimate relation which has been proved to exist between mental processes and the pulse and respiration. Several years ago, for example, Prof. Stoërring, of Bonn, found that feelings of pleasure and its opposite produce well-defined changes in respiration. Prof. Benussi of Graz has discovered that analogous effects are caused by lying Cards imprinted with various letters, figures, and diagrams were distributed among a class of students, each of whom was required to give a truthful description of the card given to him, unless the card was marked with a red star, in which case its recipient was required to describe it incorrectly. In either case he was watched attentively by his fellow students who, ignorant of the nature of the card, tried to guess from his manner whether he was lying or telling the truth. The observers made many mistakes, pronouncing false statements true, and conversely—a result which confirms the statement made above in regard to the difficulty of detecting falsehood by the speaker's manner and appearance.

Respiratory tests, however, gave unerring and unequivocal results. The time occupied in inspiration and in expiration was measured immediately before and after each card test, and it was found that the utterance of a false statement always increased, and the utterance of a true statement diminished, the quotient obtained by dividing the time of inspiration by the time of expiration.

The importance and scope of this discovery are obvious, for it furnishes a certain and objective criterion between truth and falsehood. Even when a clever liar endeavors to escape detection by breathing irregularly he is likely to fail in the attempt, for Benussi has investigated such cases and found that voluntary changes in respiration do not alter the result.—Abstracted from *Die Umschau*.

The Hawaiian Volcano Observatory

THE Hawaiian Volcano Observatory grew out of a lecture delivered at Honolulu in 1909 by Prof. T. A. Jaggar, Jr., of the Massachusetts Institute of Technology. The interest aroused by this lecture led a number of prominent citizens of Hawaii to subscribe funds toward founding an observatory on Kilauea, but the project remained dormant until the Summer of 1911, when the Institute of Technology sent an expedition to Hawaii under F. A. Perret, who was accompanied by Dr. Shepherd of the Carnegie Geophysical Laboratory, as a high temperature expert. The remarkable investigations carried out by this expedition, including measurements of the temperature of liquid lava, revived interest in the plan of founding an observatory, and in October, 1911, the Hawaiian Volcano Research Association was organised in Hawaii and Massachusetts. This association has provided funds for the erection and maintenance of the observatory, while the scientific work is directed by the Massachusetts Institute of Technology. Prof. Jaggar has been director of the observatory since July, 1912. The observatory issues a weekly bulletin, as well as a more elaborate semi-annual report. The Whitney Laboratory of Seismology is a branch of the work, fostered through an endowment fund presented to the Institute of Technology in 1909 by the Whitney estate of Boston. In the brief period since the observatory was established it has become a Mecca for the vulcanologists of the world, and its facilities are placed freely at the disposal of scientific visitors. Dr. Arnold Heim of the University of Zürich made a remarkable series of photographs here in 1912 for publication in Dr. Stille's "Geologische Charakterbilder." Last Winter the Hawaiian Volcano Research Association sent Prof. Jaggar to Japan to study the eruption of Sakurajima.

Rat Exterminators in England

IMPROVEMENTS in one direction invariably lead to other improvements either incidental or additional. The United States Consul at Sheffield, England, tells of the attempts made to exterminate the rats infesting the steel works and large stores of that city, and goes on to say that an opportunity will shortly occur in Sheffield to demonstrate the value of American rat exterminators. What is known as the killing shambles and the fish and meat market, located right in the center of the city, are to be pulled down in accordance with the new town planning scheme of the city authorities. When this does occur, it is recognized by the public that the homes of millions of rats will be destroyed, and articles and letters appearing in the local newspapers recently urged the corporation to do something to prevent the migration of this vermin.

Elastic Celluloid Varnish may be made as follows: Cut one ounce of celluloid into fine shreds. Add to a solution of ten ounces of acetone and ten ounces of amyl acetate and stir it well. Do not wait for it to dissolve. Cork tightly and set in a warm place. To make a thicker varnish add more celluloid, but a thin varnish is most elastic. To secure colors add aniline dyes dissolved in a little alcohol to the acetone solution.

Displacement, 27 500 tons **Speed**, 25 knots. **Armor**, waterline belt 13½-inch middle belt 10-inch upper belt 8-inch under water belt 2-inch. **Guns**, eight 15-inch sixteen 6-inch twelve 3-inch anti aeroplane guns

The British super-dreadnought 'Queen Elizabeth

An Electric Brake for Automobiles

AUTOMOBILES are growing more and more electrical every day, although their chief motive power is gasoline. We have now electric lights, electric horns, electric starters, and electric gear shifters. The latest electrical appliance for the automobile is the electric brake

About two years ago we described an electric starter in which a small motor of very high speed was used to turn the engine over The motor was far smaller than would be required to do the work if it were connected directly to the crankshaft of the engine Indeed, a gearing of 250 to 1 was interposed, permitting the motor and a flywheel it carried to acquire such a momentum in a brief interval as to carry the pistons over beyond the compression point.

This same principle is now being used to operate the emergency brake of an automobile It has the advantage that the driver of the car does not have to lean over, as in the present system, and feel around for a brake lever while keeping his eye on the road and endeavoring to steer his machine with one hand, but needs, merely, to operate a small hand lever right on his steering wheel. The brakes may be applied to any degree of pressure desired. When the wheel is absolutely locked a friction clutch comes into play, which prevents breakage of the parts. No resistance is introduced in the motor circuit, but the current is admitted to it directly Because the operation is momentary, there is no danger of burning out the motor, even though it be greatly overloaded

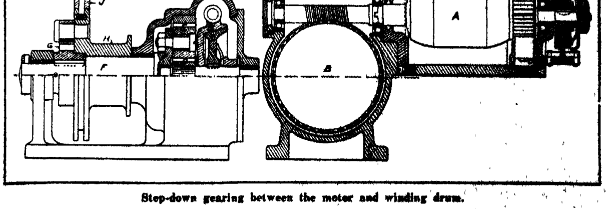
The accompanying drawings show the details of construction The motor shown at *A* drives a worm-wheel *B* This in turn, through friction wheel *C* and gearing *D*, *E*, drives the shaft *F*. On shaft *F* is a ratchet wheel *G* adapted to be engaged by pawls mounted on the winding drum *H* A cable from this drum runs to the emergency brake. Mounted on the cable drum *H* is a friction stop *J*, adapted to come into contact with the fixed stops on the casing when the brakes have been drawn up to the locked position This prevents further turning of the drum and consequent breakage of the cable By regulating the frictional contact of the stop *J* with the drum *H*, the desired maximum tension on the brake cable may be adjusted to a nicety.

Every time the brake lever is touched to admit current to the motor, the armature of the motor speeds up to an enormous speed, which is transmitted through step-down gearing to the brake drum, causing it to wind up the brake cable By successive momentary operations of the brake lever, the drum may be made to wind up its cable with a step-by-step movement until the required pressure on the brakes has been attained. Or, in case of emergency, the lever may be thrown on full, when the brakes will lock the wheel almost instantly The brake bands are preferably oiled, so as to cushion the action of this brake To release the brake, the brake lever is moved to reverse position. In place of the cumbersome controller shown in the photograph of the machine, a simple double throw switch has been devised with an automatic snap release, to prevent sparking The current used by the brake motor is no more than is used by an electric horn.

So convenient is this brake that no doubt it will be used in place of the ordinary foot brake. It is interesting to note that an electric brake of this type is being tested now on a street railway car in this city

Emergency brake lever on the steering wheel.

The brake motor and drum.



Step-down gearing between the motor and winding drum.

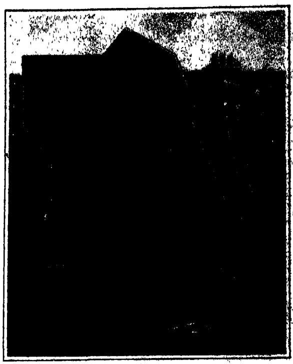
The Thalassioscope

By Dr. Alfred Gradenwitz

DR AURELIO DE GASPARIS, of Naples University, has devised an ingenious apparatus for the study of organisms at the sea bottom, which, thanks to its high magnifying power, enables all phenomena of submarine life to be watched from a considerable distance. The "thalassioscope," as the apparatus is called, will keep the image constantly in focus, thus allowing even the swiftest movements of marine animals to be followed without shifting it Its remarkable simplicity of construction reduces absorption due to refraction to a minimum.

The apparatus comprises a floating stage on which the observer is seated, and which, by means of paddles, can be moved in any direction. At the foot of this floating stage there is fixed a wide tube about four feet long and twelve inches in diameter, carrying a spur at the end. In this wide tube there moves another smaller one, to the upper part of which a large lens of about ten-foot focus is applied.

The outer tube is, moreover, provided with a binocular optical system about three feet long, comprising two lenses of about six and one half foot focus. This tube is inclined at an angle of about 45 degrees, and carries in its upper part a photographic camera and a [illegible] protective hood for the [illegible] the thalassioscope floats along the [illegible] the observer, looking through the [illegible] unwonted spectacle. He may [illegible] along the bottom of the sea, any [illegible] outside world vanishing completely. [illegible] Florideæ, red, violet, and purple, [illegible] of vivid colors, may be seen side by side with [illegible] brown and blackish Fucoids and [illegible] times assume the shape of a fan, and [illegible] as many undulating ribbons, and [illegible] massed together in bushes [illegible]. After the plains come valleys, and after these [illegible] in whose unfathomable depths swarms of fishes dart to and fro. Strange forms, of which you cannot distinguish either shape or color, dazzle the eyes by their rapid and seemingly disorderly movements. The rocks are covered by myriads of gay-colored [illegible], blended by degrees in the blue chasm, and finally disappearing altogether in unknown depths.



The thalassioscope as it appears when in use.

The spectator has the same impression as a diver, but for his feeling perfectly safe from the dangers of the sea bottom and far removed from its deathly silence which so often strikes the diver with terror.

Since everything is highly magnified, the observer is in a position to note such details as would be lost completely to the naked eye; the floating cage affords an excellent vantage ground for studying at his ease the secrets of marine biology, his specimens living in their natural element where their movements are not hampered in any way, as is, e. g., the case in an aquarium.

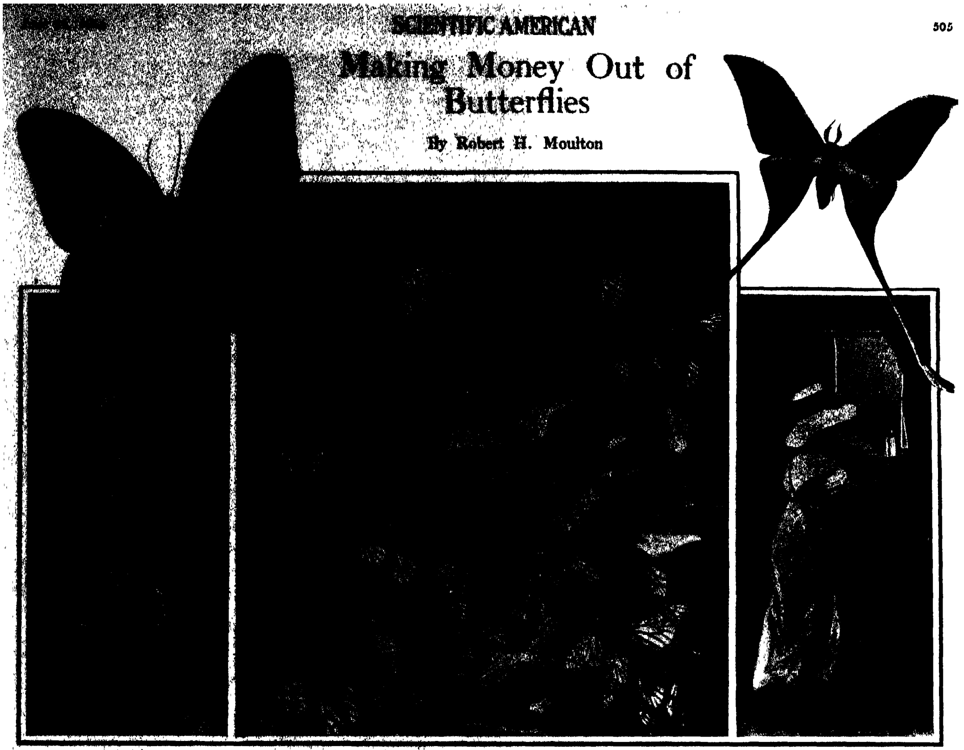
Can England Be Attacked from the Air?

THE possibility of an aerial attack upon England and other matters relating to aerial warfare were discussed at a recent meeting of the Royal United Service Institution. Col. Jackson read a paper upon defense of localities against such attacks, referring in the first place to the fleets which Germany and France will likely possess in three years, and this he thinks will be no less than forty or fifty airships of high power and an almost unlimited range, carrying a 50-ton load and traveling at an average of 60 miles an hour. No doubt the range of airships will be 1,500 miles before long. He then points out the danger of an unexpected attack upon England, and considers that the airship is far from being on the decline, or at least will not be so until armored aeroplanes prevail. Even then the airship will have manifold uses for supply of armies or transport of wounded. Soon the aeroplane will be armored so as to resist fire, and mounted by two or three men it will become indispensable in all army operations. Aeroplanes should have a machine gun on board, or a small cannon of the Pom-pom type, which had some success at Transvaal, and was recommended by the French General Langlois. At least a bomb-dropping device is needed, but he considers that a good one is not devised as yet. Then considering an attack on Great Britain—and this also applies to other places—he thinks that many points would be exposed to an attack in three years or so, but destruction of fortified places is not much to be feared, for each of these will possess defensive means. Airships hardly fly higher than 5,000 feet, so that they will be a good target for the guns. But serious damage could happen by dropping bombs upon other places, such as towns, army storehouses and factories, oil and gasoline stores, wireless telegraphy posts, and especially railroads and trains. However effective a preventive attack may be during the day, it will be difficult for aeroplanes to keep track of airships at night and prevent them from dropping bombs upon large cities such as London. He hopes that the Geneva convention as to attacks upon unfortified places would be respected, but there is no certainty about this in time of actual war, as recent experience shows, and besides, such rules did not include aircraft, so that they need to be revised. In case of bomb-dropping at night, it would be almost impossible for an aeroplane fleet to work against an airship, for the aeroplanes need some light in order to be able to steer, to see their position and to land, while the airship can sail almost without noise and without light. Only an airship fleet would be a sufficient means of defense in that case, hence the need of a sufficient fleet appears to be evident.

Pennsylvania has about seven and one half million acres of timberland, one eighth of which is owned by the State. The total value of the State's forests is 138 million dollars.

Making Money Out of Butterflies

By Robert H. Moulton



Ready for a butterfly hunt with poison bottle and net.

A wonderful group of migrating monarch butterflies.

Catching moths with bottle and lamp on a sugared cloth.

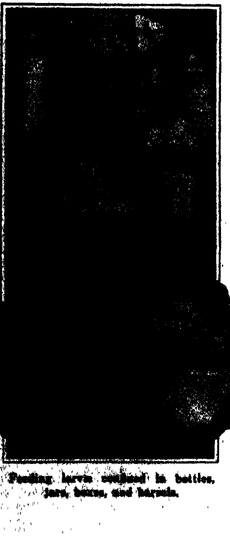
XIMENA McGLASHAN of Truckee, California, last Summer first began catching and preparing butterflies and moths for the scientific market. She was but eighteen years of age; she had no previous instruction in the work; she had no capital; her apparatus was home-made; she averaged for the season fifty dollars a week.

These combinations seem remarkable. But almost as remarkable is the fact that, though Miss McGlashan's case is exceptional, it need not be so. This successful young money-maker states that there are ten thousand places where butterflies and moths may be sold, and, of course, there are ten thousand times ten thousand localities in the United States where the insects may be snared. Every locality has its special varieties; hence, the eager demand from a market that can never be glutted, never, even, be satisfied. The butterfly business, or to speak more accurately, butterfly farming, for the raising of the winged beauties also constitutes a very important part of the industry, is open to every man, woman or child who has access to woods, meadow or back lot where butterflies are wont to gather. Few but the scientifically trained are in the business, not because a knowledge of entomology, or the science of insects, is required, but for the reason that scientific men, as a rule, being close-mouthed, are not inclined to let the public into their affairs very intimately.

The first season's work netted her $520. Twenty thousand eggs, larvæ (or caterpillars) and pupæ (larvæ in the cocoon stage) of butterflies and moths were also stored away for the Winter, a "stock" with which to make a magnificent start in the Spring.

The original apparatus was as follows: Several wide-mouthed bottles, each containing a small quantity of cyanide, in a leather case to be strapped to the shoulder; a few paper boxes; a butterfly net; a pair of delicate forceps. Cyanide may be bought in cake form at 30 or 60 cents a pound. A piece of No. 9 wire, a light bamboo rod, a few cents' worth of gauze, and there is the net. Forceps are to be had for [illegible] cents the pair. Not much capital required for a start in so lucrative a business, was there? With this simple equipment she sallied forth upon her first conquest of the butterfly lands. Cyanide is both a deadly poison and a harmless [illegible]—harmless to the butterflies, at any rate, if they are not permitted to remain corked up with it [illegible]. Each specimen Miss McGlashan [illegible] transferred to the bottle, the quicker [illegible] to injure itself by its struggles [illegible] through the gauze. As she worked, every few minutes she carefully sorted over her catch. Males of the commoner species in perfect condition she let perish, with the purpose of disposing of them in the market at once. Only the absolutely perfect specimens will sell. Dealers can never be imposed upon; their eyes are far sharper than those of any amateur No half-rates for slipshod work: it is perfection or nothing that is demanded in this business. Those males slightly bruised or with wings battered, were reserved for breeding purposes, as were females. Miss McGlashan had already arranged with a dealer to take her mounted specimens at a flat rate of 5 cents each. From the very first, therefore, she began to make money.

Feeding female moths and butterflies while they are laying eggs in boxes and paper bags.



Feeding larvæ confined in bottles, jars, boxes, and barrels.

The processes, if intelligently studied, are relatively simple, deft touch and painstaking care being the chief requisites Cork-lined boxes, cork linoleum, which, by the way, is a good deal the cheaper and every bit as good, or insect cork may be used to secure the cyanide-asphyxiated insects safely for shipment. For this purpose special pins, which sell at $1.25 per thousand, or less in larger lots, must be used. Any other sort of pins won't do at all. They are not fine enough, and will utterly spoil the thorax of the insects through which they should always be put in mounting. Another pair of forceps larger than the ones used in ordinary handling of the butterfly or moth must be employed, to take hold of the pin from beneath the insect and force the point firmly down into the bed of cork. If fingers should so much as even slightly brush or touch a specimen, the chances are pretty certain that it is irrevocably ruined. One fact, a very important one, too, must be strictly borne in mind by the shipper: he should be certain the dealer who has agreed to make purchases of him is fair and reliable. Miss McGlashan's prisons for her captives probably were the least expensive part of her inexpensive equipment. These were the little paper boxes previously mentioned. As she sorted her booty of the meadows she transferred each of the living to its separate box. These little box prisons were but temporary. On the captives being taken home, other arrangements for keeping them had to be made. Of course, the purpose in preserving the females alive is to secure eggs and, ultimately, more butterflies. This method naturally enables the butterfly farmer to obtain a much larger and more perfect "crop" than he would otherwise. But it is rather difficult to induce the female to lay unless conditions are entirely satisfactory, though moths are not at all particular in this respect. Most butterflies in captivity prefer to lay their eggs in gauze bags; all insist that a piece of their special

(*Concluded on page 511.*)

Hearing Ourselves as Others Hear Us

IT is a well-known and frequently observed fact that many singers and performers on musical instruments exhibit a degree of complacent satisfaction with their own efforts, which is not at all commensurate with the amount of pleasure they have given their audience. But the exaggerated view they form of the musical value of their achievements is not entirely due to that vanity to which our poor human nature is so prone. They do not, as a matter of fact, hear themselves as others hear them. This is particularly the case with a singer. A singer produces and hears a note at the same time, the sound being conveyed through the Eustachian tube of the ear. The *external sound*, the sound heard by the audience, is not, in the ordinary way, heard by the singer at all.

Mr. Donald McIlardy, a voice specialist of many years standing, has invented an apparatus to obviate this disadvantage under which all singers and instrumentalists have hitherto labored. The apparatus is extremely simple and consists of a half-sphere made of metal, connected to a long flexible, metallic tube. The tube terminates in two branches, the ends of which fit in either ear. The sound produced by the performer, after impinging on the open half-sphere, travels down the metallic tube to the performer's ears. The sound heard by the performer in this way corresponds exactly to the effect produced on an audience.

Although so simple, the apparatus in its present form is the outcome of a good deal of experiment. Various-shaped openings for the metal receiver have been tried, but the half sphere opening is the only one which gives satisfactory results. Various materials have been employed in the construction of the connecting tube, with the result that the metal at present employed has been found to possess distinct advantages. As was to be expected, it was found that a rubber tube gave very poor results.

The present writer took the opportunity of playing a piano solo to a small audience, first with and then without the apparatus, and the audience were unanimous in declaring that the second performance was distinctly better, although to the writer they sounded identical.

How to hear yourself play the piano and sing.

"Marble Light"

By Our Berlin Correspondent

IT has been known for a long time that marble in very thin sheets is *translucent*, and that colored marble sheets give the most striking effects. A German engineer, Mr. Hermann W. Engel, of Hamburg, by a *special* polishing and impregnating process, has, however, succeeded in endowing marble slabs of considerable thickness (1/10 to 3/4 inch) with a transparency far superior to that of opal glass. After being polished on both sides, these marble sheets are impregnated with diverse oils, at high temperatures, under heavy pressure. This process is not only less costly than [illegible] only a few thousandths of an inch in thickness, but insures far greater solidity. The color effects of such marble slabs, on account of the greater thickness, are much more beautiful than in the case of the thin layers. Skylights of colored marble have been provided aboard some German steamers, and, when lighted at night by electric incandescent lamps, produce effects of remarkable beauty.

Some most interesting tests have been made by Dr. Voege at the Hamburg State Laboratory, which go to show that light passing through this marble possesses many striking qualities, and is equally commendable for economic and hygienic reasons.

From comparative tests on opal glass and impregnated marble plates, respectively, it is seen that the latter possess far greater transparency. Moreover, they are lighted uniformly up to the edges, and when inspected side by side with opal glass, appear perfectly white. Impregnated marble is especially efficient if an electric lamp arranged within a reflecting box be used as the source of light, which source can be closed by a marble slab or milk-glass plate. Whereas the former only absorbs about 20 per cent of the total radiation, the latter, in fact, holds back as much as 40 per cent. In spite of its greater transparency, marble is fully equal to milk-glass, as far as its power of absorption is concerned. The most striking feature of marble light, however, is its remarkable softness and pleasing effect.

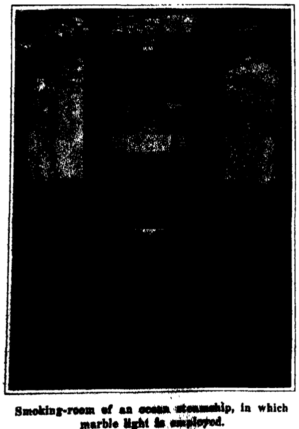
A device whereby the players of wind instruments can sustain tones indefinitely.

The central picture shows the course of the air-current from the mouth-piece of device *A*, at the corner of mouth, around the structure of the mouth to the mouth-piece of instrument *B*, at the center of lips. At the moment of the player's intake of breath through the nostrils *C*, the entrance to the lungs from the mouth is automatically closed by the pressure of the base of the tongue *F* against the soft palate *D*. The stop-valve on the device *E* prevents the re-entrance of air into the tubing of the device once it has entered the mouth; therefore, the only outlet for the air is by the natural course, cleaving to the roof of the mouth *G*, striking the soft palate *D*, and working backward along the surface of the tongue *F* to the mouth-piece of the instrument *B*. Meanwhile the air admitted to the player's lungs enters only by way of the nostrils *C*. He may even breathe out through the nostrils and still indefinitely sustain the tone of the instrument by the air-current which the pedally-operated bellows supplies. That air-current is warmed and moistened to the degree of the human breath by an incandescent bulb and immediately adjacent water-chamber contained within the bellows structure.

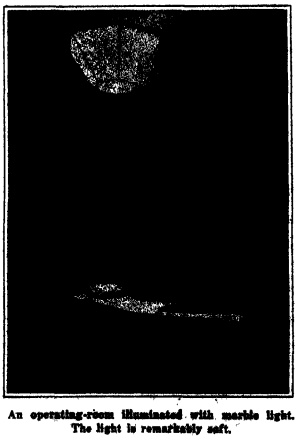
Artificial Lungs for Bandsmen

By Harry Chapin Plummer

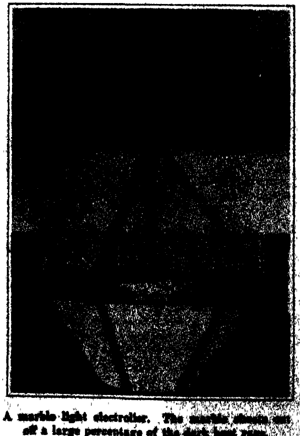
TO provide an efficient physical means for fulfilling the superhuman demands imposed upon wind instrumentalists by the great symphonic and operatic scores of Richard Strauss, Wagner, Brahms, d'Indy, and the modern school, a new tone-sustaining apparatus has been devised by Bernard Samuels, a native of Paramaribo, Dutch Guiana, who is at present first flutist of the Royal Opera at Schwerin, in Germany, and chamber musician to the Grand Duke of Mecklenburg-Schwerin. The new device consists of a foot-bellows having a water-chamber with incandescent bulb and a length of rubber tubing fitted with a stop-valve and mouth-piece, all simply attached, for the convenience of the player, to the instrument that is being played, but in no sense forming a part of the instrument. By means of the water-chamber and electric-light bulb, the air forced through



Smoking-room of an ocean steamship, in which marble light is employed.



An operating-room illuminated with marble light. The light is remarkably soft.



A marble light electrolier. The marble sheets cut off a large percentage of the dark heat rays.

[illegible] pressure of the foot upon the bellows is such [illegible] and [illegible] to meet the degree of the human breath and is transmitted to the mouth by the rubber tubing. It enters through the mouthpiece at the corner of the mouth and, performing the natural circuit of the mouth, passes out through the mouthpiece of the instrument, at the center of the mouth. So, when the performer is drawing breath through the nostrils, the current of air started by his foot sustains the tone upon which he is engaged. It will matter little whether that tone be a single note or an elaborate cadenza—the pressure of the bellows will sustain it indefinitely, if desired. Although the air from the bellows is carried into the mouth, the stop-valve within the tubing prevents the entrance of any air into the bellows.

Composers will now be afforded a well-nigh unlimited scope in writing for brass and reed instruments. Already Richard Strauss has specifically designated the device in more than one passage of his "Festival Prelude."

The device is now well established in the principal symphony and opera orchestras. The Royal Opera of Berlin, of which Dr. Strauss is the director, was one of the first representative institutions to have the entire brass contingent of its orchestra equipped with the apparatus.

Just what aid the device renders to important musical performances may be judged from the fact that it was employed in the recent rendition of the "Nibelung Ring" cycle of music-dramas by Wagner at the Metropolitan Opera House, and it was the first occasion at that theater when the full strength of the horns could be employed in certain passages simultaneously. In the prelude to "Das Rheingold," for example, the tubas are called upon to hold a tone for ninety bars. Until now this has been a physical impossibility for the individual player, who has had to take breath after every three or four bars. Now, however, all the players can sustain the tone for the full ninety bars. Similarly, in the "Dragon music" of "Siegfried," the tuba will be able to sound its stentorian and raucous bass tones without having to chop and break the phrases, as hitherto.

James T. Allen

ON May 26th James T. Allen died at Washington, D. C., from a complication of troubles. He was a veteran examiner in the Patent Office, having been appointed September 18th, 1868, from the Twenty-sixth Congressional District of New York, making his service nearly forty-six years in length. He was a careful and conscientious worker, with a wide acquaintance and friendship among patent attorneys. During his service he compiled digests of plows, seeders, and planters, harrows, grain drills, and air and gas engines, and for a time edited monthly periodicals relating to these digests. These publications were in wide demand, many having gone to Germany and other European countries. For forty years he had charge of the important class of seeders and planters, and served the Government and inventors with entire satisfaction.

Decisions on Patents

THE Jenner patent, 804,726, for a candy-pulling machine has had its claim 1 held invalid and its claims 7 and 8 valid and infringed in Hildreth v. Lauer, & Suter Company; and in the same case the Dickerson patent, 881,501, for a candy-pulling machine has had its claim 1 held valid and infringed and claim 2 valid but not infringed. In Lewis Blind-Stitch Machine Company v. Arbeter Felling Machine Company, the Lewis patent, [illegible], for a blind-stitch sewing machine has been held valid but not infringed. The Lane design patent, [illegible], for a design for a piano case, has been held valid and infringed in Bush & Lane Piano Company v. [illegible]. The Parsons patent, [illegible], for pneumatic tire casing, has been held valid and infringed in Parsons [illegible] Company v. E. J. [illegible] Company. In Crown Cork and Seal Company of Baltimore City v. Sterling Cork and Seal Company, the Painter patent, [illegible], for a machine for automatically sealing bottles, has been held not infringed, while the Painter and Hawkins patent, 842,978, for an apparatus for feeding crowns to a bottle-sealing machine, has been construed and is limited, held not infringed.

Notes for Inventors

A Self-Threading Shuttle.—A. Meunier of Taunton, Mass., in patent No. 1,093,718 presents a self-threading construction of shuttle which does not result in an objectionable weakening of the shuttle and can be readily applied to or embodied in shuttles now in use.

A Mail-Collecting System.—Samuel C. Cox of Washington, D. C., has patented an improvement in mail collecting in which the collecting vehicle co-operates with the mail box. The mail is delivered directly from the box into the receptacle of the vehicle without intermediate handling.

The Label and the Laundry.—Joseph French of Woonsocket, R. I., has secured patent No. 1,093,985 for a label-attaching improvement in which the label is fastened temporarily to the article by a thread which, while it holds the label to the article during the required treatment, can be easily withdrawn to detach the label.

Electric Lamps to Indicate Liquid Level.—Patent No. 1,093,745 has been issued to John A. Turner of Washington, D. C., in which the level of liquid in a tank is indicated electrically through the aid of a vertical series of lamps whose individual circuits are opened and closed by the rise and fall of the water in the tank, thus showing visually the level of the water in the tank.

A Re-Winder for Music Sheets.—Patent No. 1,093,813 was issued to Frank C. White of Meriden, Conn., assignor to Wilcox & White of same place for an improvement in music playing instruments, having for its object to stop the forward travel of the note sheet at the end of the composition, re-wind the sheet on its spool and to finally stop the machine when the sheet is fully re-wound.

Secret Photograph as an Aid to Subsequent Identification.—In patent No. 1,094,073 Alfred Ilg of Zürich, Switzerland, provides for photographing a person without his knowledge. He time stamps and dates the photograph so it may be subsequently used for identifying the person. The invention is especially adapted for use by police and pawnbrokers.

The Water-proofing of Concrete.—Richard K. Mead of Roland Park, Md., in patent No. 1,092,933 has patented a process and concrete composition wherein waterproof qualities are imparted to cement by adding to the cement a powdered filler whose particles are oil-coated so that when made into concrete or the like it will be impervious to water.

Using Paper to Indicate Broken Rails.—In patent No. 1,092,986 Joseph H. Gardside of Philadelphia, Pa., provides strips of paper attached to railroad rails throughout their lengths. These strips will be broken by a passing train if the rail be defective and thus plainly indicate to the track-walker the defects in the rail.

An Elihu Thomson Turbo Ship-Steadying Patent.—Elihu Thomson of Swampscott, Mass., assignor to General Electric Company, in patent No. 1,093,159 utilizes the rotating parts of the turbo generator as a great gyroscope to steady the ship and reduce her rolling, the turbo generator having a vertical shaft.

Protecting the Hat from Rain.—Christine Mullaney of New York city has patented an emergency covering for hats, which cover is made of waterproof paper and can be secured to the hat by the customary hat pins employed to hold the hat on the head.

Preventing the Splitting of Railway Ties.—A method of preserving railway ties has been patented in No. 1,093,230 to William E. Williams of Chicago, Ill. The tie is compressed and a metal band is secured tightly around the tie at the compressed places with a view to preventing the checks and splints induced by the spikes and the slowly developed splits and cracks resulting from the traffic.

Two Moving-Picture Apparatus Patents.—Adolph F. Gall of West Orange, N. J., assignor to New Jersey Patent Company of West Orange, has secured patents Nos. 1,092,905 and 1,092,906, the first providing a screen and operating means therefor for protecting the moving-picture film from the heat emanating from the projecting lamp, while the second patent controls the passage of light through a projection aperture of the lamp house in such manner as to insure the closing of the projection aperture of the device when the latter is in any position except the projecting one, and will uncover the aperture when the device is moved into a projecting position.

A Patent to Tom Johnson.—Margaret J. Johnson, as administratrix of Tom L. Johnson, deceased, of Cleveland, Ohio, has secured patent No. 1,090,213 for a high-speed railway in which a stationary element along which the truck is movable has a portion above the truck and means for creating both a tractive and lifting effect on the truck by which a magnetic field is created which passes between the stationary element of the truck and such field is distorted in the direction that the truck is adapted to move.

Two Patents to Charles Francis Jenkins.—Charles Francis Jenkins, the well-known inventor of Washington, D. C., has secured patent No. 1,089,645 for an aeroplane engine in which a closed crankcase has opposite depressions, receiving cylinders, and is revolubly mounted upon a fixed axial crankshaft, piston structures passing through openings in the crankcase with an aeroplane propeller carried by and rotating with the crankcase. He has also secured patent No. 1,089,646 for a motion-picture camera in which a lens moves in an endless path and carries with it a portion of a film, which portion is exposed while the lens moves through a portion of its path, the movement of the lens through another portion of its path bringing a fresh portion of a film into its axis.

Preparing Mail Matter for Posting.—Patent No. 1,090,499 to John W. Poller of Takoma Park, Md., assignor to Molyneux Mailing Machine Company of Buffalo, N. Y., is for a machine which folds up a sheet of paper in flat form, removes an envelope from a pack of envelopes, inserts the sheet of paper in such envelope after opening and positioning the envelope, suitable means being provided for directing the sheet into the open envelope.

Correcting the Drawings of Patent Applications.—An order has recently been issued by the U. S. Patent Office, having for its purpose to stop the constant mutilation of the Office records. Hereafter corrections and alterations of the drawings of pending patent applications will be made only by the draftsmen employed by the Patent Office, a reasonable charge to be made by the chief draftsman for such corrections as may be necessary.

A Charles Steinmetz Patent.—In patent No. 1,088,740 to the General Electric Company as assignee of Charles P. Steinmetz, there is presented a method of producing an arc in a transparent chamber between terminals, one of which is vaporizable at low temperature and the arc being colored by the addition of a chemically active metallic substance while the enclosing chamber is protected from injury by neutralizing the chemical activity of the metallic substance.

A Motor Field Structure which Operates as a Pulley.—Ethelbert M. Frazer of Yonkers, N. Y., has patented an electric motor particularly adapted for use in connection with a tractor elevator. The motor has a stationary armature and a rotatable wheel structure which is encircled by the armature and is so constructed that it can be used as a pulley to operate a flexible driving connector.

Legal Notes

New Combination of Old Elements.—In United Gas Improvement Company v. Gas Machine Company, Fed. Rep 211-672, the court has held that a new combination of old elements, which, by their co-operative action, produce a more beneficial result, amounts to invention, which is not negatived by the fact that such co-operation requires the mediation of an operator. Also in the same case it was held that where a patent contains description of only one form of a thing which will perform the same office in other forms, the court will apply the general rule that the description covers all equivalent forms and the form described will be treated only as the one preferred

New Use of Old Material.—In O'Brien-Worthern Company v Stempel, Circuit Judge Sanborn said "But the application of an old device to a new one is not always or generally even patentable It is only when the new use is so recondite and remote from that to which the old device has been applied or for which it was conceived that its application to the new use would not occur to the mind of the ordinary mechanic skilled in the art that there is invention in the conception of its application to the new use, and the old use fails to limit the claim of such an application " Along the same line Circuit Judge Lacombe in Archer et al v Imperial Machine Company, said "Sometimes it is true a change of material will produce a novel and unexpected result which might evidence invention "

'Supreme Court Decision on Ten-Year Clause Trade-Marks.—Some interesting matters are included in the decision of the Supreme Court of the United States, the opinion being rendered by Mr Justice Hughes, in the case of Thaddeus Davids Company v. Davids & Davids, trading as Davids Manufacturing Company The registered trade-mark was the surname "Davids," registration being secured under the provisions of the ten-year clause of the act. The court said that as the mark consists of an ordinary surname, it was not the subject of exclusive appropriation as a common-law trade-mark, and the applicant who by virtue of actual and exclusive use is entitled to register his mark under this clause (the ten-year clause) becomes on due registration the "owner" of a "trade-mark "

Some Adjudicated Patents.—In the Ney Manufacturing Company v G A Swineford Company, the Taylor patent No 486,812 for a track for hay carriers has as to claim 1 been held void as covering a broad combination of which the patentee never claimed under oath to be the originator or the inventor, and the Anderson and Holstein patent No 683,425 for process of making fabric-covered ornaments was held not infringed in Holstein v Seeland Ornamental Company; the Rhodes patent No. 777,488 for a fish bait or lure was held valid and infringed in William Shakespeare, Jr. v. Enterprize Manufacturing Company, and the Carter patent No 777,714 for a culvert was held not infringed in Carter v Burch Plough Works Company The Niez reissue patent No 13,163 (original 916,361) for a disk harrow was held valid and infringed in Bucher & Gibbs Plow Company v International Harvester Company

The Term of Design Patents.—Heretofore it has been the practice to hold applicants for design patents to the election of term, whether three and a half or seven years, specified in the application, but Commissioner Ewing has with the approval of the Secretary of the Interior amended the Patent Office Rule of Practice to permit the applicant who may in his application request the issue of the patent for one of the shorter terms to amend his application at any time before the allowance of the application, upon the payment of an additional Government fee, and to request the issue of the patent for the longer term, so that if the application originally elects a term of three and a half years or seven years, the applicant may extend the term to seven years or to fourteen years as may be desired.

RECENTLY PATENTED INVENTIONS

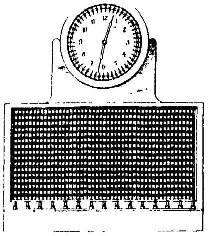
These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

NECKBAND FOR SHIRTS.—J. H. FUNK, 546 W 156th St., New York. The invention provides a neckband cut so as to have an overlapping end portion for thickening the band at the end carrying the button, so as to prevent pressure of the button against the neck. The design of the neckband is such as to reduce the movements in the manufacture thereof to a minimum, and at the same time provide button guards both at the top and back.

Electrical Devices.

ANNUNCIATOR SYSTEM.—T. A. HAUGAARD, care of B and B Dept., U P R R, Cheyenne, Wyo. To do away with the use of a "call sheet" by hotel clerks whose failure to record the desired call or to make the call after entering it, has led to much distress and loss of time to travelers, Mr Haugaard has invented this system, in which the traveler may see for himself that the plug is in the annunciator, when he may be assured that he will be awakened at the desired time. Its capacity is unlimited and it can be installed without much expense beyond that of installing the ordinary annunciators.

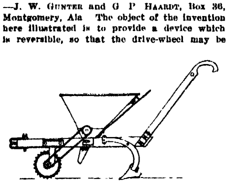

AUTOMATIC CALL SYSTEM FOR GUESTS OF HOTELS

CONNECTING CLIP FOR ELECTRICAL CONDUCTORS.—J. G ELKIN, care of Elk Manufacturing Co., 68-72 E 131st St, New York. The clip here illustrated may be securely fastened to insulating conductor wire, enabling it to be quickly and conveniently attached to or detached from a binding post or the like. It consists of a pair of spring-pressed jaws pivotally connected and a clamp on the pivots of the jaws, adapted to engage the bare end of the wire conductor, this clamp consisting of a hollow screw with tapered bore adjustable upon tapered clamping members, thereby providing a quick-action gripping of the wire.

CONNECTING CLIP FOR ELECTRICAL CONDUCTORS.

Of Interest to Farmers.

REVERSIBLE FERTILIZER DISTRIBUTOR.—J. W. GUNTER and G P HAARDT, Box 36, Montgomery, Ala. The object of the invention here illustrated is to provide a device which is reversible, so that the drive-wheel may be placed either at the front or at the rear of the plow blade, thereby permitting the fertilizer to be deposited and plowed under, or to be placed in the furrow and covered by the follower. The device is provided with a feed which may be regulated as desired. Means are provided for agitating the fertilizer and for forcing it toward the feed opening.


REVERSIBLE FERTILIZER DISTRIBUTOR.

FENCE STAY.—J. A. NICKOLAUS, R. F. D No. 3, Mount Pleasant, Iowa. The fence stay consists of a single strand of wire so formed as to provide an anchoring element at one end, which may be readily and quickly secured in position in connection with an erected fence, in order to support efficiently those wires between the posts of the fence, which are otherwise likely to sag.

TRACTION ENGINE.—F. HECKMAN, Maria Stein, Ohio. The traction engine has two traction wheels on a divided axle connected by differential gearing and driven by an internal combustion engine. Normally the traction engine has no rear wheels, as it is adapted to be coupled to the wagon or agricultural implement that is to be hauled. However, means are provided for supporting the rear of the tractor on supplementary rear wheels, if so desired.

SWIVEL CONNECTOR.—G. W. OAKES, care of Pittsburgh Plate Glass Co., Crystal City, Mo. This invention relates generally to swivel connectors adapted to be placed in electrical conductors in order to prevent tangling of the conductors in moving about apparatus to which they are attached. It consists of a pair of swivel terminal members to which the conductors are connected and about which there is a casing of insulating material.

MAGNETO.—W. CASEY AND I. LESSES, 384 Brock St, Kingston, Ontario, Can. Exposed wiring is done away with in this magneto and the mechanism is made waterproof. The high-tension conductors are short, thereby lessening the chances of grounds and short-circuits. The parts are so arranged that the current is delivered at maximum intensity over a long range.

ELECTRIC HORN SWITCH.—J. E FOULKS, JR., 1324 Dean St, Brooklyn, N. Y. In order to permit of turning on the electric current to an automobile horn or siren without removing the operator's hand from the steering wheel, the present invention provides a switch in the form of a ring secured to the steering wheel. By pressing the ring toward the wheel, at any point, one or more contacts are made, closing the circuit of the electric horn.

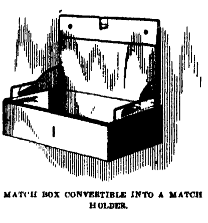
HOUSING FOR ELECTROMAGNETS.—E. GEGENBACH, care of Duplex Electric Co., 514 W. 57th St, New York. The invention relates particularly to ironclad housings for electromagnets, which will not only provide greater protection for the winding of the electromagnet, but also greater efficiency of operation. The housings are made of sheet metal bent to suitable form, with certain portions co-operating with the armatures of the electromagnets.

Of General Interest.

ENVELOPE.—G. SCHNITZLER, 100 Amerman Ave, Arverne, N Y. The principal objects of this invention are: To provide an envelope having a tearing section reinforced to provide a uniting member, the structure of which is unbroken; to provide means for preventing the introduction within the tearing area of the letter or enclosure when deposited in the envelope, and to provide means of the character mentioned readily and cheaply applicable to envelopes constructed in accordance with the present invention.

CLEANING METAL SURFACES.—C. H. THOMPSON, Harrington House, Amblecote, Stourbridge, England. The process consists in placing articles without metallic connection with the electrodes in a bath of any suitable chlorid, sulfate, or nitrate solution, preventing the articles from contacting with the electrodes, arranging said articles in series with each other and the electrodes, and passing an alternating-current through the bath, the current, by this arrangement of articles and electrodes, passing through the articles in succession.

MATCHBOX.—H. W. GASKILL, Columbus, New Mexico. The device here illustrated consists of a box containing matches, which is so constructed that it may be used as a match safe or holder. The top of the box may be extended and secured to a wall, while braces are provided for securing the body of the box at right angles to the top portion.

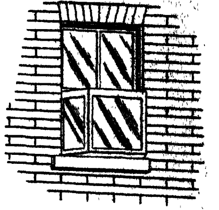

MATCH BOX CONVERTIBLE INTO A MATCH HOLDER.

ERASER HOLDER.—C. E. MOON, Box 972, Oxnard, Cal. Among the objects of the present invention are: To provide a simple, inexpensive, and strong eraser holder which is neat in appearance, has no projecting portions which will interfere when it is placed in a pocket, which can be easily placed on a pencil or removed from it, and which will permit the consumption of substantially the entire eraser.

PLASTIC COMPOSITION.—J. E BECK, Sunnyvale, Cal. This plastic composition is adapted to be used in lieu of ordinary plaster walls and ceilings, or for flooring, pavements, plaster boards, shoe leather, trunks, suitcases, drums, barrels, boxes, etc. It consists of straw digested in lye, and subsequently pulped, mixed with flour, zinc chlorid, and coloring matter.

BOTTLE GUARD.—C. [illegible], Box 27, Douglas, District of Alaska. The invention relates to non-refillable bottles and provides means for preventing the insertion of a tool or implement. This means consists in a web that runs across the neck of the bottle with an opening in the web and a downwardly-extending arched cap over the opening. A [illegible] rib forms a further obstruction to the introduction of a tool.

WINDOW.—J. R. BOILEAU, Minocqua, Wis. The invention provides means capable of being applied to an ordinary window to convert it into an extension or bow window, so as to permit the occupant of a room to see laterally as well as directly outward. The device may be inclosed by a perforated covering in warm weather, to prevent the entrance of insects, dust, and the like, or with an imperforate, transparent covering, in Winter, to prevent the entrance of cold air, without obstructing the view.


AN EXTENSIBLE BOW WINDOW.

UMBRELLA.—C. SCHMIDT and A. HIRSCHWITZ, 1342 St. Bernard Ave., New Orleans, La. The invention has for its object a provision of simple and inexpensive means for connecting the ribs and stretchers of the umbrella to the stick in such manner that they may be easily detached and removed for the purpose of repairing, without necessitating the removal of the cover or disassembling the elements of the umbrella.

PROCESS FOR MOLDING PLATES.—A. J. JARMAN, care of J. J. Travers, 45 Brittam Ave., Elmhurst, Long Island, N. Y. The object of the invention is to produce an inexpensive light and reliable molding plate for half-tone or line work in typographic or intaglio printing, which plate will receive all the impressions of a suitable matrix, no matter how fine, without warping, and give a good hold to the printing ink.

FURNACE DOOR OR CLOSURE.—J. B. PHILLIPS and J. A KAPLAN, 523 Avington Ave., Zanesville, Ohio. This invention relates to the doors or closures of smelting furnaces where exceedingly high heat is generated. As heretofore constructed these doors are apt to burn out frequently. Accordingly, the present invention provides an all-refractory closure, consisting of a single slab of firebrick or the like with a novel holder constituting a gripping and suspending means for the refractory closure.

Hardware and Tools.

BOLT AND NUT LOCK.—D. D. TULLOCH, 266 Market Street, Newark, N. J. The invention provides an improved bolt and nut lock in which a bolt of uniform dimensions with respect to the standard size bolt used, is designed for co-operation with a nut of special design in that it is increased in thickness and counterbored to receive a plug attached to the bolt and forming means to lock the nut to the bolt against rotation.

Heating and Lighting.

TAKE-DOWN COOK RANGE.—G. N. FRASER, Eugene, Oregon. The present invention, which is an improvement on a previous take-down cook range invented by Mr. Fraser, consists of four sections, namely a firebox section, a flue section opposite to and facing the firebox section and intermediate upper and lower sections. All four sections may be readily and quickly assembled and taken apart, and when free from one another may be conveniently stored in a minimum space.

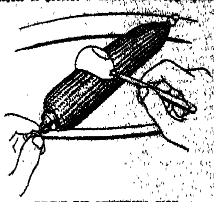
TAKE-DOWN COOK RANGE.

HEATING APPARATUS.—J. McGUIAN, Savannah, Ga. The furnace has heating chambers connected by pipes with a delivery flue for delivering the [illegible] and a [illegible] bers and [illegible] suction thereon [illegible] ing chambers, to draw the [illegible] them and into the flue.

GAS TUBE COUPLING.—[illegible] catur and Walter [illegible]. The invention relates to a [illegible] conducting gas from a [illegible] lamp or stove. It provides [illegible] ler arranged for convenient [illegible] gas nipple without danger of [illegible] dentally detached.

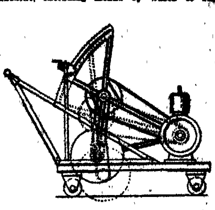
Household Utilities.

CORN BUTTERER.—H. M. [illegible], [illegible] er St. (Room 504), New York, N. Y. The invention relates to tableware, and has for its object to provide a device for evenly spreading butter on an ear of corn. The device consists of a handled bowl adapted to contain butter and a concave perforated cover adapted to fit upon the peripheral face of an ear of corn.


DEVICE FOR BUTTERING CORN.

Machines and Mechanical Devices.

MACHINE FOR CUTTING PAVING.—GREGORY PERKINS, 505 West 21st St., Los Angeles, Cal. Mr. Perkins' present invention relates to a machine for cutting asphalt and other paving through the use of a power driven circular saw, his object being to provide a machine, including means by which to support a circular saw in such manner that it may be adjusted toward and away from the ground and held in selected position for cutting the paving or other material to a desired depth.


MACHINE FOR CUTTING PAVING.

BOBBIN-STOP.—C. NORDELL, Gilbertville, Mass. The invention provides a means for stopping the bobbin when "piecing up." The bobbin is mounted upon a shell which has frictional engagements with a rubber clutch member engaging the driving pulley. To stop the bobbin the shell is raised out of engagement with the clutch by means of a lever, and is stopped by frictional engagement with a fixed yoke.

THREAD-CUTTER.—J. A. DOWD, Box 411, Fall River, Mass. This thread cutter is adapted to cut threads on pipes and form spaced threaded portions. The cutter is provided with a threaded peripheral surface with the thread or spurs at different distances from the center of the cutter so as to cut straight or tapering threads on the tube or bar in a continuous operation.

DRILL.—J. T. CURNOW, Palatka, Mich. The principal objects of this invention are to provide means for clearing a drill hole while drilling, to introduce a water jet for washing the hole and cooling the drill point, to utilize the power applied to the drill for water-jetting the drill hole and to provide means for controlling the supply of water to the hole.

AMALGAMATOR.—S. BUSS, Greenwood, Cal. The invention provides a device within the means of the private miner, although capable of embodiment in apparatus of large size, for the treatment of gravels to recover the "rusty" gold formerly lost, owing to the formation of rust on the gold bearing material which resisted the amalgamating action in the operation of the ordinary apparatus.

APPARATUS FOR MANUFACTURING OBJECTS FROM PLASTIC [illegible].—O. EBERHARD, Heidelberg, [illegible] many. The apparatus relates [illegible] ture of soap, sweets, and the like [illegible] number of diversely colored [illegible] through a die to [illegible] in the mixing chamber [illegible]

[illegible]

[illegible] MACHINE.—G. D. [illegible], [illegible] A machine for vending packages preferably of [illegible] shape is provided by the present invention. The hopper in which the packages are contained has its outlet normally closed, but when a coin is placed in the slot, the outlet becomes operative, and upon operating means manipulated from the outside of the casing, the package is delivered from the hopper.

FRUIT WASHING MACHINE.—A. R. Stevens, care of Gulf Iron Works, Tampa, Fla. The invention provides a fruit washer which has comparatively few moving parts and therefore is not liable to get out of order easily. It is adapted particularly for washing oranges or lemons and comprises a means for rotating the fruit so as to expose all parts to the cleansing action.

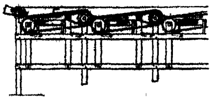
FRUIT SIZER.—A. R. Stevens, care Gulf Iron Works, Tampa, Fla. The object of this invention is to provide a device by means of which fruit may be graded into sizes according to the largest diameter of the fruit. A further object is to provide means for adjusting the parts of the sizer so as to vary the sizes of the fruit deposited at any one point.

BOX PRESS.—A. R. Stevens, care Gulf Iron Works, Tampa, Fla. The present invention relates to box presses utilized to press and hold the cover on a fruit box while it is being nailed and strapped. The invention provides simple and inexpensive apparatus in connection with such a press which will be durable and effective in use and which embodies certain novel features of construction.

SAWMILL.—R. H. Orr, R. F. D. Route 3, Sebastopol, Cal. Mr. Orr's invention is an improvement in sawmills, and has for its object to provide a simple and easily operated machine in which the saw is capable of a large variety of adjustments, both when in horizontal and when in vertical position.

TORPEDO STEERING MECHANISM.—J. J. Dallier, Great Lakes, Ill. Among the principal objects of this invention are: To provide means for maintaining a torpedo on a relatively straight course, to provide an operating mechanism for a steering gear, to effect the above-mentioned purposes easily and positively, and to provide operating means for the steering rudder, said means being removable from service position, without loss of time and without undue effort.

MACHINE FOR GRADING FRUIT.—F. C. and C. M. Jaquette, R. F. D. No. 1, Grand Junction, Colorado. An improvement in fruit graders is provided by the present invention, which has for its object to furnish a mechanism adapted for grading fruit as it is moved by endless carriers, and wherein a series of carriers is provided, each arranged to deliver from the machine all fruit below a certain size.



MACHINE FOR GRADING FRUIT.

COMBINED BORING MACHINE AND LATHE.—H. J. Wyatt, Longbranch, Washington. The object of this invention is to provide an improved boring machine and lathe arranged to permit of convenient use for boring or turning purposes, the machine being provided with a spindle capable of receiving a boring tool or a face plate, and the spindle being mounted to turn and to slide in the direction of its axis.

LOOP SETTER.—J. M. Triplett, 6 North Columbia St., Wenatchee, Washington. This invention relates to moving picture apparatus and provides means for setting the loop of the film without interfering with the operating of the machine. The mechanism is of a simple nature under the immediate control of the operator. It is adapted for use in connection with any standard moving picture machine.

MEASURING AND DELIVERING MACHINE.—H. A. [illegible], Box [illegible], Hammond, Ind. The object of this invention is to provide an improved measuring and delivering machine more especially designed for measuring and delivering loose material, such as coal, grain, ore, and the like, and arranged to insure the free passage of this material from a supply chute to a measuring receptacle.

PROJECTING APPARATUS.—J. H. [illegible], [illegible] Golden Street, Newburgh, N. Y. It is the object of this invention to provide an [illegible] especially designed for use as an advertising medium and arranged to display the images of desired [illegible] on a screen, wall, sidewalk or other surface, together with a revolving image having differently colored sections to form an attractive feature of the display.

SAWING MACHINE.—J. M. [illegible], 921 Poplar Street, Wilmington, Delaware. The invention has for its object to provide an improved sawing machine arranged for quickly and conveniently sawing trees with a view to felling them, and to allow of sawing the felled tree or log into desired lengths of cordwood lumber and other mill material.

AUTOMATIC ANNUNCIATOR.—J. H. [illegible], 13 Golden Street, Newburgh, N. Y. The invention relates to a projecting apparatus for projecting pictures or other subject matter on a screen, walk, sidewalk or other surface. The annunciator is arranged to announce automatically the time and legends representing advertisements or titles to vaudeville acts, or titles for moving pictures, or the like.

Medical Appliances.

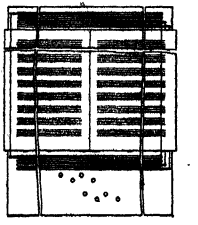
SANITARY MEDICAMENT EJECTOR.—C. E. Brasefield, care of R. C. Collins, Schuylkill Fruit Building, Pottsville, Pa. Mr. Brasefield's invention provides an improvement in the class of devices comprising a rigid tube and an expansible soft rubber bag attached to the tube, for use in applying a medicament to the affected portions of the mucous membrane lining cavities of the body.

Musical Instruments.

MUSIC TURNER.—J. E. Poot, Wetumka, Okla. The invention provides a mechanism for turning the leaves of a piece of music in succession. The mechanism is operated by the foot of the player, and is so arranged that it may be applied to a piano without radical changes in the construction of the instrument.

ROSIN CAKE.—D. C. Lohmann, West Milton, Ohio. The invention relates to a cake of rosin for use in connection with the bows of stringed musical instruments. The rosin cake is formed with soft and hard rosin, the soft rosin serving to hold the hard rosin to the bow. In the soft sections bluing is incorporated, so as to whiten the bow.

MUSIC LEAF TURNER.—A. J. Illig, Box 19, Roseilville, Wis. The present invention provides a leaf-turning mechanism which is manually controlled, but motor-driven, as shown in the accompanying drawing, which is a face view of the apparatus. Rock shafts are provided, with arms extending above and below the music, while wires connecting the arms pass between the leaves of the music. By touching the proper button, any rock shaft may be operated to turn a leaf to the right or to the left, as desired.



MUSIC LEAF TURNER.

Prime Movers and Their Accessories.

PISTON PACKING.—C. N. Bowden, Guantanamo, Cuba. The present invention is intended more particularly for embodiment in hydraulic pistons employing a cup packing, and it is the design of the invention to provide a novel means associated with the cup packing to prevent the latter from being forced between the piston and cylinder wall when either or both become worn.

BOILER AND SUPERHEATER.—J. A. Frey, Silver Spring, Md. An object of the invention is to provide a device by means of which steam which is generated in a boiler may be returned to a superheater disposed within the combustion chamber of the boiler whereby the steam is superheated for use in metallurgical operations, and in which steam at a lower pressure may be taken from the same boiler to run an engine or for any other suitable purpose.

ENGINE.—R. Hunter, 1022½ Sprague Ave., Spokane, Washington. Mr. Hunter has invented an engine of simple design, being an internal combustion engine of the rotary type. The invention provides a governor mechanism adapted for controlling the fuel supply in addition to the usual cam-operated inlet valve.

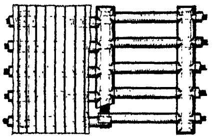
INTERNAL COMBUSTION ENGINE.—F. D. Calkins and A. C. Johnson, Sunnyvale, California. The invention is an improvement in internal combustion engines, and has for its object the provision of a removable liner for the valve chambers of the engine, shown in a series of patents still pending, as means of permitting the linings to be removed, when worn, and replaced by others.

Railways and Their Accessories.

HYDRAULIC WEIGHING SCALE.—E. J. Walters, Groveland, and W. P. Symonds, Arlington, Cal. The invention relates to hydraulic-weighing scales, more particularly of the type used for weighing heavy articles, such as cars of a railway train. In operation, the cars of a train are drawn successively and slowly over the rails on the weighing scale, and a record of the weight of each is made automatically upon a chart.

EXTENSION-PLATFORM FOR CURVED RAILWAY-STATIONS.—J. J. Porth, 72 Main St., Corona, N. Y. To close the gap between a car and a curved station platform and thus avoid accidents from persons falling between the platform and the car, Mr. Porth has provided a series of extension devices, consisting of spring-pressed platform sections, which are normally projected beneath the station platform, to intercept the spaces between the cars and platform.

BRIDGE.—O. Freeny, Carthage, Miss. The invention relates to simple and effective means for protecting and prolonging the life of sills and sleepers of bridges. Sheet-metal shields are provided, which extend longitudinally and transversely above the sleepers and the sills, to protect them from water dripping through the cracks between the transverse flooring strips. The life of the sills and sleepers is thus greatly prolonged, and it is merely necessary, from time to time, to replace the flooring



PROTECTOR FOR BRIDGE SILLS AND SLEEPERS.

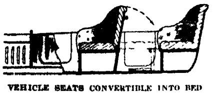
AUTOMATIC TRAIN STOP.—P. N. Mathis, 1639 Pacific Street, Brooklyn, N Y The invention has particular reference to means for preventing an electric car or a locomotive equipped with air-brakes from passing a danger signal, except under direct orders and at low speed. The invention provides mechanism under control of a semaphore or other signal arranged to engage a device carried at the top of the locomotive or car when the signal is kept at the danger point.

VESTIBULE CAR CURTAIN HOLDER —M. J. Roche, 63 Wayne St., Jersey City, N. J. The invention relates to improvements in curtain holders for vestibule cars, and has for its object to provide an improved structure which may be readily attached and detached, and which will automatically become detached when a predetermined strain is brought thereon, whereby the curtain is released without tearing.

FENDING DEVICE.—M. Cohen, 62 Avenue B, New York, N. Y. The invention provides a fending device adapted to be applied to street cars, automobiles, or other vehicles. The device comprises a movable shield adapted to be locked automatically in front of the fender, to shield a person struck by the fender and prevent him from being rolled or thrown to a position to be run over by the car.

Pertaining to Vehicles.

HINGED SEAT FOR VEHICLES.—J. L. Beeson, Milledgeville, Georgia. The object of this invention is to provide the front seat of an automobile or other vehicle with a back which may be let down so as to form, in connection with the rear seat of the vehicle, a bed This would be found particularly useful for camping purposes. The design is such that when the seat back is replaced in its normal position, it will have the appearance of a seat of the ordinary construction



VEHICLE SEATS CONVERTIBLE INTO BED

AUTOMOBILE LOCK —F. O Ulrich, care of John O. Ulrich, Tamaqua, Pa The invention provides a means for locking the steering wheel of an automobile to the bearing post sleeve, so as to prevent unauthorized interference with the wheel during the absence of the owner. It consists of a bolt mounted on the wheel and movable from the bearing sleeve, together with means for holding the bolt in operative or inoperative position.

REAR-END SIGNAL FOR VEHICLES — C. F. Marston, 104 India St., Brooklyn Mr Marston provides a foot-pedal controlling mechanism for a vehicle whereby the driver of the vehicle may actuate signs selectively to indicate his intentions, the sign being placed at the rear of vehicle, but being selected with the foot pedal electrically

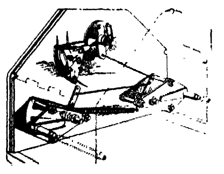
DRAFT EQUALIZER.—A. Lange, care of H. M. Kidder, Fremont, Nebr. The principal object of this invention is to provide means for equalizing the pulling strain exerted by a wide-spread team, to provide a spreader for distributing a team to advantage irrespective of the line of draft and to provide a hitching device whereby unequal pulling strains are equalized.

SPRING WHEEL —G. E. Crawford, Britton, Okla This automobile wheel comprises a hub, side plates carried thereby and formed with elliptical seats, spacing blocks alternating with the seats and formed with screw threads, radially disposed spiral springs with elliptical ends accommodated in the seats and engaging the threads of the spacing blocks and a rim projecting radially into and engaging the outer ends of the springs

TRACTION WHEEL —S H Summerscales, Box 1891, Winnipeg, Manitoba, Canada. In the present invention a traction wheel is provided with a plurality of spuds, for contact with the ground to cause the wheel to "take hold" while the spuds themselves do not sustain the load. The arrangement is such that the spuds contact with the ground in advance of the contact of the wheel tread

CUSPIDOR ATTACHMENT FOR VEHICLES —W. M Carson, Stovall, Miss In carrying out this invention Mr Carson provides the floor of an automobile or other vehicle with an opening which is normally closed by a spring door that is adapted to be retracted and opened by pulling a device connected thereto and easily accessible to the occupants of the vehicle.

LOCKING DEVICE FOR AUTOMOBILE HOODS.—A. E. Marshall, Box 215, Asheville, N. C. The object of this invention is to provide means for locking or unlocking automobile hoods so as to prevent access to the engine or other parts contained therein The locking mechanism serves also as a means for actuating a switch to cut out the sparking circuit Both sides of the hood, as well as both ends, may be simultaneously locked or unlocked



LOCKING DEVICE FOR AUTOMOBILE HOODS.

Designs.

DESIGN FOR WALL PAPER —E J Walenta, Sr., care of Standard Wall Paper Co., Hudson Falls, New York The design for wall paper represents a scene through a wooded lane with hills in the background

DESIGN FOR A HAMMERHEAD —W J Fleischauer and H Richardson, 159 Hayne Avenue, Pontiac, Michigan. The distinguishing feature of this design consists in providing at the side of a hammer head a flat circular boss

DESIGN FOR WALL PAPER —E C Baeck, 233 37th St., Brooklyn, N Y The patent covers an ornamental design for wall paper in which the effect of a woven fabric is produced

DESIGN FOR A GAME BOARD —M J Fitzgerald, Lancaster, Los Angeles County, California The game board bears on its face a picture of an animal, such as a bear with a series of circles symmetrically disposed on the board and numbers printed in the circles

DESIGN FOR A THREE-VALVE SHOWER BATH BODY —F Bockelman 551 W 174th St, New York

DESIGN FOR A TWO VALVE SHOWER-BATH BODY —F Bockelman, 551 W. 174th St, New York

DESIGN FOR WALL PAPER —E. C. Baeck, 233 37th St. Brooklyn, N. Y

Note.—Copies of any of these patents will be furnished by the Scientific American for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper

---

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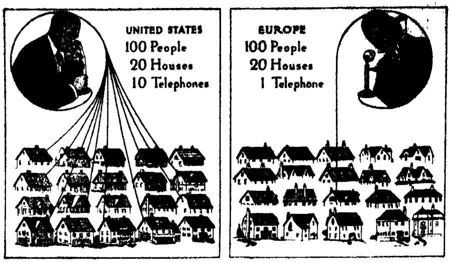

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Forty-five Years of Air-brake Evolution

(Concluded from page 498.)

severe service requirements were for a long time partly offset by closer inspection, better maintenance and more care and skill in the handling of the equipment in service.

Recent Improvements in the Air Brake.

The nature of the mechanism, itself, however, has been rapidly and radically modified.

The brake apparatus, in the first place, has been reconstructed so that the mechanism on each car assists in propagating the application in routine as well as in emergency use, thus insuring the prompt and uniform action of all the brakes and affording a more responsive brake for the train as a whole. In "releasing," uniformity and certainty are attained by automatically restricting the release and recharging of the brakes at the head end of the train. This insures greater certainty of response of the brakes toward the rear end of the train and a more uniform action on the train as a whole and is a large factor in preventing the shocks and strains which cause rough handling and break-in-twos.

To meet down-grade conditions the "empty and load" type of brake has been evolved. Instead of the ordinary brake, designed to control the empty car, and about one-third as efficient with a loaded car, we have for heavy grades the "empty and load" brake providing a braking force on each car substantially in proportion to its weight. The more uniform braking of loaded and empty cars improves level as well as mountain-grade service, since any inequality of braking effort on different vehicles in mixed trains of loads and empties produces rough slack action and damaging shocks.

Increased consumption of compressed air took place through greater loss by leakage for longer trains and larger cars, through greater actual use on the larger cars and in more frequent and heavier brake application. To augment the supply of compressed air, compressors of large capacity and high efficiency have been developed.

While the brake could be made quicker acting and more powerful by propagating the application through the train more rapidly, by raising the cylinder pressure and by shortening the time required in obtaining this high maximum pressure, thus making substantially safer the passenger train with heavy cars, it came to be recognized that full results depended upon transmitting the enhanced and quickened pressure to the rim of the wheel efficiently and without material loss. This brings us to the foundation brake rigging—the brake beam and levers—and the brake shoe. Inefficiency in these parts of the mechanism, as the Lake Shore tests of 1909 graphically demonstrated, made it impossible to reduce the length of emergency stops on heavy passenger trains going sixty miles an hour to less than 1,200 feet with the most powerful and rapid-acting brake then available. The result has been a highly efficient "clasp" type of rigging; two brake shoes to the wheel instead of one greatly improved the performance of the rigging and relieved the brake shoes, trucks and journals of excessive and unbalanced forces to such an extent as to permit the stops already described at well under 1,000 feet.

Routine or "service" stops, as previously pointed out, are second in importance only to emergency stops. The service functions have been improved so that a fully effective automatic or manual emergency application is possible, even at a moment when a "service" application is in progress. In case the brake-pipe reduction is continued below a fixed minimum danger point an emergency application is made automatically. By the use of electro-pneumatic control the application and release of all brakes can be made uniform and simultaneous throughout the train.

The motive of economy as well as that of safety has been assuming more and

[illegible]

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Inquiry No. 9376. Wanted, the name and address of a manufacturer making clock-work mechanism for running window display machines as employed by safety razor manufacturers.

Inquiry No. 9377. Wanted, the names and addresses of factories making [illegible] for export.

Inquiry No. 9378. Wanted, the name and address of a manufacturer of [illegible] such as are sold in 5 and 10 cent stores, with a mirror and a cardboard back.

Inquiry No. 9379. Wanted, [illegible]

more in true position, and the present appreciation by railway officials and manufacturers of this aspect of the braking art promises still further progress in the future.

Making Money Out of Butterflies

(Concluded from page 505.)

kind of food plant shall be at hand; and some few cannot be induced to do their duty under any circumstances, though coaxed in every way possible. But when a female butterfly does lay she makes all efforts on the part of her keeper seem worth while. Often she produces anywhere from one to three hundred eggs. It is hardly profitable to maintain in captivity the commoner species; dealers can use but few of them as a rule. However, as Miss McGlashan soon discovered, the beginner had better secure all the varieties possible. The experience is valuable. Males necessarily must be admitted for breeding purposes. After mating, however, the sexes should at once be segregated.

The feeding of the captives is no problem. They thrive equally well on dried apple soaked in honey or sugared water. A bit of this may be fed daily.

Members of the rarer species bring big prices. There are some butterflies in the Sierra Nevada Mountains worth five dollars each. Incidentally, it might be worth while for the amateur butterfly farmer to know that these mountains also produce a beetle that dealers are anxious to snatch up at that same substantial price of $5 a head. This beetle makes an excellent side line.

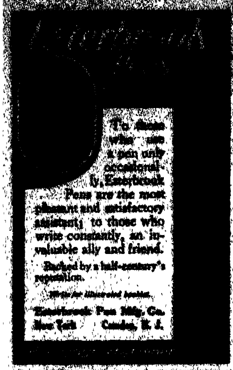
But $5 apiece pales into insignificance compared with the almost fabulous sums that certain elect lepidoptera command in Europe. Some of the butterfly farmers there have reared specimens selling for $5,000. An Englishman named Head, who has been in the business for nearly thirty years, has disposed of hundreds of thousands of "flies," and holds the doubly envious position of having made a *fortune* from his enterprise, and of having become a world authority on the rearing of the insects.

Miss McGlashan does not market her "crop" on the basis of individual value of specimens. She has a contract, whereby she receives a uniform price for all, whether rare or common. The reservation, however, has been made by the dealer that the commoner varieties shall be limited to one hundred each.

To catch moths, sugared cloths must be stretched while it is still daylight, on the trunks of trees. If one throws a light upon these cloths after darkness falls, many moths will be found gathered feeding. A carbide lamp is the best for the purpose. It will not blow out in any wind. The price is about two dollars. The light-dazed moths are easily swept into wide-mouthed bottles.

Larvæ or caterpillars, which should be captured whenever found, are also quite easily taken at night. Where the leaves of bushes or trees appear as if they have been fed upon, trays, paper, or sheets should be set upon the ground directly beneath. At 9 o'clock or even later, the raid may be made upon the larvæ. The bushes and branches must be beaten vigorously with a stout rod or pole to break the hold of the feeding larvæ. Dozens, even hundreds of caterpillars, have been taken by Miss McGlashan in this manner in a single evening. Larvæ should be taken even more eagerly than the fully developed female butterflies. The intermediate stages of egg-laying and hatching can thus be dispensed with. The taking of both moths and larvæ can, of course, be combined the same evening. It is advisable to do this work alone as moths are easily frightened away by noise.

All the work of butterfly breeding centers in the care of the caterpillars. It is of vital importance, first of all, that the little creatures have their own sort of food. Usually this may be known, of course, by a knowledge of the sort of bush the captives were found feeding upon. However, where the farmer has hatched his caterpillars from eggs, a problem pre-



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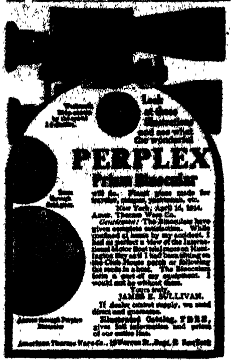

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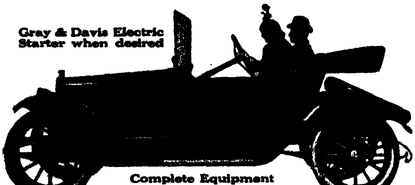

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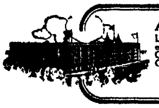

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sents itself. But the right sort of food plant may be discovered by making various experiments, half a dozen different varieties of leaves being introduced each day until it is observed that the larvæ begin to cluster upon some one of these. There is no danger of immediate starvation, for they will subsist for a little time upon the shells from which they have been hatched.

Miss McGlashan found that test tubes are the best place in which to keep the eggs. As they must be examined every day to see whether or not they have hatched, the importance of having transparent receptacles that may also be easily handled, is obvious. The eggs of some species of butterflies will hatch within a few days, others not until the following Spring. Larvæ and eggs should be put in cold storage for the Winter. The reason for this is that the food plants not being available, the caterpillars would starve. Thus, the eggs will not hatch till Spring, and the caterpillars will hibernate until warmer days arrive.

At intervals larvæ molt. This process goes on half a dozen times during the crawling stage of their existence. When they begin to spin cocoons, the nursing period for the farmer is over. His last step is to remove the cocoons to a barrel or box securely covered with gauze.

Miss McGlashan thus gives directions for taking care of young caterpillars:

"A few days after they have hatched, remove your brood of worms to a jelly glass having a tight-fitting tin cover. They may remain here until they become a quarter of an inch in length. Then place them in large-mouthed bottles with tight-fitting covers. They require very little air. Large bottles or fruit jars make fine breeding cages for broods of caterpillars. A candy jar is ideal, because you can watch the development of the larvæ through the thin, transparent glass. If you have hundreds of a kind, get a tight barrel, loosen the top hoop, place a covering of cloth or gauze over the open head of the barrel and fasten it down closely by means of the hoop, and you have a first-class breeding cage. Three inches of dirt and leaf mold should be placed in the bottom of each bottle or barrel used for larvæ, because they love to hide in this during the daytime, and many species bury themselves before they pupate. Put in fresh leaves of the food plant daily, take out the old food and keep your breeding cages clean. Of course, you may build elaborate cages of wire gauze, but the simple ones are just as good."

The Improvement of the Irish Potato has been the subject of much recent investigation on the part of the United States Department of Agriculture. An initial step has been the exploration of that portion of South America of which the potato is supposed to be a native. Convincing proof has been obtained that this plant was indigenous to the high Andes region of both Peru and Bolivia, where it has been under cultivation for 2,000 years. Experts of the Department have collected more than 250 sorts of cultivated and wild potatoes, which will be used in the development of more vigorous races especially adapted to the diverse areas over which the potato is cultivated in the United States. The Department is also investigating new methods of utilizing potatoes analogous to those that have been so successful in Germany.

Salton Sea continues to dwindle in size and increase in salinity through evaporation. The last (seventh) annual analysis of its water, made by A. E. Vinson, showed that the total solids in the water had increased in a year from 846.55 parts to 1,002.56 parts per 100,000, an increase of 18.4 per cent for the period. The water may now be considered as 1 per cent brine.

Mr. J. I. Craig, late director of the meteorological service of Egypt, has been transferred to other duties in the Survey Department (of which the meteorological service is a branch), and is succeeded by Mr. H. E. Hurst.

NEW BOOKS, ETC.

Animal Flight. A Record of Observation. By E. H. Hankin, M.A., Sc.D., Associate Fellow of the Aeronautical Society of Great Britain. London: Iliffe & Sons, Ltd. 8vo.; 413 pp.; illustrated. Price, 12s. 6d. net.

The author once asked Lord Kelvin if he could explain the baffling phenomena of soaring flight, and received the answer, "That which puzzled Solomon puzzles me also." "Animal Flight" is largely devoted to bird soaring, although other modes of bird flight are included, and there are chapters dealing with bats, flying fishes, and dragon-flies. The volume is unique in that the writer has no theories of his own to proffer. He simply presents atmospheric conditions, time and space measurements, and actual accomplishments, leaving the field of deduction to those who may follow him. He has had splendid opportunities for intimate observation, and has not failed to make the most of them. There are instances of heavy birds soaring in calm, tropical air, and he differentiates between true soaring flight such as this and the more usually seen mode in which our birds of the temperate zone skillfully seek and utilize air currents. Although the author avoids speculation, it is clear that he believes the possibility of soaring flight to be traceable to a certain condition of the air, a static energy dependent in its turn upon sunlight. Hence we find him continually applying to the air the terms "soarable" and "unsoarable." Perhaps the more immediate value of the work lies in its studies of wing positions, camber, etc., in the various modes of flight.

Noted Murder Mysteries. By Philip Curtin. London: Simpkin, Marshall, Hamilton, Kent & Co., Ltd. 8vo.; 301 pp. Price, 7s. 6d. net.

Without straining toward sensationalism, allowing the actual circumstance and situation to exert their own power, Mr. Curtin narrates nine of the world's strangest cases. Whether Marie Lafarge was martyr or murderess will probably never be known, but in its day her case rocked emotional France, and as retold by the present writer, still has the power to arouse in the reader strong conflicting emotions. But a very low wall divides the commonplace from the tragic. Certain stimuli are raised above the threshold of consciousness. The wall is leaped; and immediately some humdrum life appears before the world in all the colors of romance, with tonal values ranging from humor to tragedy. Strange flashlights play upon the inscrutable depths of human nature, and the observer is held motionless, fascinated. For those who care to indulge in this form of intellectual dissipation, "Noted Murder Mysteries" will furnish a ready means.

Sun Lore of All Ages. A Collection of Myths and Legends Concerning the Sun and Its Worship. By William Tyler Olcott, A.M. New York: G. P. Putnam's Sons, 1914. 8vo.; 346 pp.

Those who are familiar with the author's companion volume, "Star Lore of All Ages," need no assurance that in beauty of format and wealth of illustration this later work is worthy of a place beside the former. From earliest times, and among the most primitive peoples, the heavenly bodies have made an intense appeal to religious, superstitious, and scientific instincts. Imperious and dominating among these celestial mysteries rides the sun, and the wealth of the mythology clustering about it is well represented and set forth in the twelve chapters of this work. In them is included the solar creation myths of the North American Indians, the legends of India, Persia, and Greece. The solar festivals of many lands are described, and their folk lore is frequently presented in the language of their own literatures. Thirty full page plates embellish the text, many of them reproductions of beautiful sculptures and paintings that are not so well known as to carry with them that familiarity which, while it can never breed contempt in the artistic mind, yet takes off the finest edge of enthusiasm.

Terry's Japanese Empire. Including Korea and Formosa. With Chapters on Manchuria, the Trans-Siberian Railway, and the Chief Ocean Routes to Japan. A Guide Book for Travelers. By T. Philip Terry, F.R.G.S. New York: Houghton, Mifflin Company. 12mo.; 1150 pp.; 8 specially-drawn maps, and 21 plans. 1914 Edition. Price, $5.

Aided by the use of thin but good paper, the author and publishers have packed a really astonishing amount of information into a volume that just comfortably fits the hand. The result is a guidebook dealing substantially with a great diversity of things. The "three R's" of the ordinary guidebook—routes, rates, and recreations—are supplemented by admirable little essays on art, architecture, language, and religion. The main portion of the book maps out seven routes which, together, include all the points and localities that offer special appeal to the tourist. The writer knows his business, as he knows his Japan, and his laborious and conscientious work should be eagerly welcomed by all who contemplate travel through or residence in this most interesting part of the world. Terry's "Mexico" is the standard guide to that much troubled (and troublesome) country, and is the only case where a Baedeker has been successfully supplanted. We have no reason for believing that Mr. Terry will be less successful in his newest venture.

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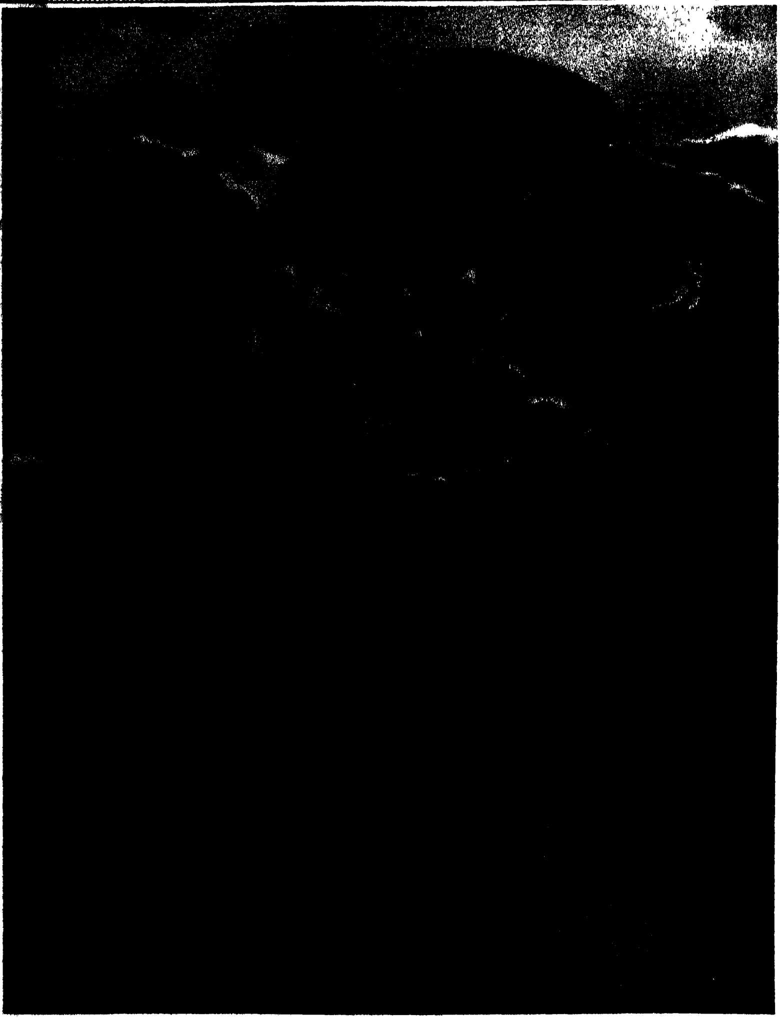

SAVING MEN FROM A SUNKEN SUBMARINE

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short* and the facts *authentic* the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement

Valuable Data for the Aeroplane Builder

THERE can be no doubt that the excellent progress which is being made in Great Britain in practical aeronautics is in great measure due to the experimental work which has been done at the National Physical Laboratory for the Advisory Committee for Aeronautics. The extent and detail of the work of the committee may be judged from its fourth annual report, which contains more than four hundred pages, and embodies no less than twenty-eight separate reports. Limitations of space prevent any elaborate review of this work, and we shall merely attempt, here, to sum up the more important findings.

From the report on experiments with models of aeroplane wings we learn that good results will be secured by placing the maximum ordinate of the wing section farther from the front edge than is the present practice. Furthermore, so far as the aerodynamics of the wings are concerned, there is nothing to be gained by thickening the leading edge, although there is no particular disadvantage if the edge is moderately thickened. Of considerable constructional advantage is the fact that a distinct increase may be made in the thickness of the after portion of the wing, without incurring any aerodynamical disadvantage. The value of this fact is that transverse spars of deeper section than are commonly used may be inserted toward the trailing edge of the wing. On the question as to how far results obtained with models may be applied to full-size wings, we learn that the lift-drift ratios of models should be increased from 15 to 20 per cent to make them reliably applicable to full-size wings.

A question which has attracted much attention of late years is that of the value of reflexing the trailing edge of the wings, and it has been established that to restrict or entirely prevent the movement of the center of pressure, when there is a change in the angle of incidence, it is necessary to reverse the curvature in the after portion of the wings. The laboratory tests have shown that absolutely to prevent the movement of the center of pressure in this way, about 12 per cent of the maximum lift-drift ratio must be sacrificed, and of the maximum lift coefficient about 25 per cent.

The report on the distribution of pressure over the surface of the wings brings out the fact that the tips of the wings have a very low aerodynamic efficiency. Good results, according to the report, should follow a careful investigation into the effect of variations of camber, angle of incidence, and plan form in that portion of the wings at and near the tips.

The report dealing with wind forces and moments shows that great accuracy is necessary in giving the struts symmetrical form. If they are not symmetrical, highly unsymmetrical and erratic cross-wind forces will be produced by the struts when the aeroplane yaws from its path. If the struts have a large ratio of fineness, irregularities of construction will have a small effect on the drift and the transverse wind forces. Should the ratio be less than 2½ to 1, the drift will be extremely high, and the transverse wind force will be erratic in its magnitude.

The tests on model aeroplane bodies show that good results are to be expected from giving careful attention to the design of the body. To many aeroplane builders it will be a surprise to learn that, in place of the symmetrical torpedo body form, better results are to be expected if a single boom is extended from the cockpit to the tail planes and elevators.

Tests on a model tail plane and elevator planes prove that the maximum control is reached when the elevators are turned to an angle of 30 degrees, above or below the horizontal; furthermore, the elevating or depressing moments are about proportional to the angle of depression or elevation, until the above-mentioned limiting angle of 30 degrees plus or minus is reached.

Of widespread interest will be the results obtained in the investigations of the gyroscopic action of the engine and propeller. If an aeroplane driven by a 100 horse-power Gnôme engine coupled to a 9-foot 6-inch, 2-bladed, 30-pound propeller, is caused to make a complete turn in 20 seconds, the total gyroscopic couple is found to amount to 324 foot-pounds; and a sudden manipulation of the elevator to an extent just sufficient to raise the pilot from his seat, was found to be 330 foot-pounds. According to the report, these couples are not of serious amount and they can readily be met by the ordinary controls. They act upon the aeroplane in much the same way as a gust of wind; but there is the advantage that both the magnitude and the direction of the gyroscopic couples are known and the pilot is prepared for them.

The report on model propellers endorses the present method of design in determining their section, etc. Under the present method each section of the blade is considered as a small aerofoil, and is designed accordingly. The report shows that the method is not strictly correct, and that the calculated thrust, torque, and efficiency are slightly less than that obtained by the accepted method. The laboratory experiments proved that a certain type of propeller should have had a maximum efficiency when the angle of attack was 4 degrees. This efficiency, however, was not reached until the angle had been raised to 9 degrees.

"Boats for All" a Failure

GRADUALLY, but very surely, it is coming to be realized that the only way to safeguard the lives of passengers at sea is so to build the ship which carries them that it shall act, in case of necessity, as its own lifeboat—in other words, to make the construction such that no accident could send it to the bottom with the suddenness which marked the sinking of the "Empress of Ireland."

The principle of safeguarding the passengers by providing boats for all is faulty, for the reason that it assumes that certain conditions of wind, weather, and time, all of which must be present if the boats are to be launched, will exist when the emergency calls for their immediate use. In the case of the "Titanic," these conditions fortunately happened to exist. There was no wind, the sea was calm, and the two hours and twenty minutes from the collision to the sinking of the ship provided sufficient time to utilize practically all the boats that the ship carried. In the case of the "Empress of Ireland," however, although there was no wind and the sea was calm, and although there were more than sufficient boats to carry everyone on board, the ship listed so heavily, and went under so quickly, that only a very few of the boats were got into the water.

It is gratifying to note that the *Engineer* of London, an organ of very high authority in maritime matters, has come to our point of view in this most serious question. In its issue of June 5th, in discussing the recent disaster, it says: "One cannot help reflecting that here, again, as in the case of the 'Volturno,' the principle of 'boats for all' has signally failed. The 'Empress' could have carried every soul on board in her boats, but she had no chance to use them." On another important phase of this question, the *Engineer* is in agreement with us; for farther on in the same article it says: "The 'Empress of Ireland' was built by Fairfields, in 1906, on lines that were considered the best before the loss of the 'Titanic.' She had an extensive double bottom, and was well divided, *but she had no inner skin.* (The italics are ours.) Whether an inner skin would have saved her, under the circumstances of the collision, is a question which the evidence of the divers may help to answer. . . . But there seems to have been no question of cutting her in two. The effect, from the meager evidence we have, seems rather to indicate that the plates were ripped off by the bow of the 'Storstad,' as we rip the lid off a box with a screwdriver. If the divers can substantiate this view, a very strong case for the double inner skin will be presented. For it is probable that while many ribs would, of necessity, have been badly distorted, yet the inner hull might have held, at least for a time."

We attach the more importance to this admission on the part of our contemporary, for the reason that its attitude at the time of the "Titanic" disaster was rather unfavorable than otherwise to inner skin construction. The only valid objection against the inner skin, particularly if it consists of the inner walls of coal bunkers, is that the inflow of water is confined to one side of the vessel, and that heavy heeling, which might become disastrous, would be occasioned. The answer to this is that, if provision were made for flooding the corresponding compartments on the opposite side of the ship, it would be possible to maintain her equilibrium by quickly admitting sufficient water for the purpose. Battleships are built on this principle, and there is no constructional difficulty which would prevent its being applied effectively to large passenger-carrying ships.

There is yet ample time for the consideration of amendments to the convention drawn up in London, last Winter, by the International Conference on Safety at Sea. The insertion of a clause, rendering the use of some form of inner skin on the large passenger-carrying ships, not, as it is at present, optional, but strictly obligatory, would round out and complete the otherwise excellent work of that congress.

As these words are being written, there comes the startling information that, for the third time in less than a month, a transatlantic liner has been run into by another ship. A little over two weeks after the loss of the "Empress of Ireland," the "New York" was rammed by the "Pretoria"; and a few days later, the "Kaiser Wilhelm II," while crossing the English Channel, was struck squarely amidships by another vessel. Both ships, fortunately, are subdivided far more effectively than the avearge ocean liner—the "New York" having closely-spaced transverse bulkheads, carried to an unusual height above water, and the "Kaiser Wilhelm II" carrying a continuous inner skin throughout the engine and boiler-room spaces. The "Kaiser" reports that water gained admission only to one compartment, probably a side bunker of small capacity. Had she been built as are 95 per cent of the passenger ships, the water would have had free access to the whole width of the ship.

Evolution and Physical Law

THE division of human knowledge into separate fields of science is more or less arbitrary, and chiefly due to certain peculiarities of our senses. It is therefore to be expected that the most fundamental principles of science shall be of universal application, and shall be found to hold, in some form or other, in widely separated branches of science.

In the biological sciences, one of the most fundamental principles is that of evolution by the survival of the fittest. What is there corresponding to this in the purely physical sciences?

Evolution, as understood by the biologist, is an essentially one-directional process in time, an advance or development, to use expressions which are illustrative rather than precise.

Now the physicist is acquainted with two kinds of processes. There are purely mechanical processes. A peculiar property of these is that in them time does not enter in a one-directional way. It can be shown that if all the motions of a purely mechanical system were instantly reversed, it would exactly retrace its history. There is thus nothing unique in the actual history of a purely mechanical system.

But in all other systems, and that is to say all *real* systems, which are not purely mechanical, there is dissipation of energy through degradation of other forms into heat, and through passage of heat from higher to lower temperatures. In such a system the one-directional character of time is again apparent and finds its exact expression in the second law of thermodynamics. This law can be stated in various forms. For purposes of a popular exposition, it is perhaps best presented in some such terms as these: Heat cannot, of itself and spontaneously, i. e., without compensating change of some kind, pass from a colder to a hotter body.

The more technical statement of the law is to the effect that the *entropy* of an isolated system can only increase, not decrease, with time. Or in other words, the entropy of such a system tends toward a maximum.

Now there are certain systems, as for example a system comprising several substances undergoing chemical reaction, the history of which can be forecast by application of the entropy principle alone. The system will ultimately reach a state of equilibrium in which the entropy will be a maximum. The entropy principle in such a case is *the law of evolution.*

In the case of the highly complex system presented to us by the living world, this statement alone, though it may be correct, fails to carry all the information which the biologist seeks. Still, here also, we know, evolution is a one-directional process, and it may reasonably be expected that the law of evolution takes a form similar to that of the second law of thermodynamics. Some function of the state of the system tends toward a maximum. But what is that function? This is a problem which remains to be solved.

A Wireless Receiving Installation now in use at the Duomo, in Florence, is interesting for the fact that the entire outfit, including the antennæ, is inside the cathedral. Messages received from points as far distant as Paris, Madrid, and Toulon indicate that the apparatus is hardly less efficient than if installed out of doors.

[illegible]

[illegible]

[illegible] and Passenger Cars.—It is [illegible] Pennsylvania Railroad Company that passenger [illegible] a useful life of 20 years, at [illegible] value as scrap will be only [illegible]. An allowance [illegible] and renewal is made for [illegible] for locomotives and passenger [illegible] of 4 per cent. is made [illegible] and renewal. This seems to us to be a [illegible]

[illegible] Lifeboats.—After the burning of the [illegible] steamship "Columbian," one of the [illegible] for no less than two weeks in the path of [illegible] steamers, but although the wretched seamen [illegible] they could not attract their attention by signals. Of the 15 men in the boat, 11 died before [illegible]. Had the lifeboat carried a submarine bell, it could have signaled Atlantic steamers which were suitably equipped, even at a distance of several miles. The suggestion is well worth careful consideration.

Fewer Rail Failures in New York State.—Thanks to better methods and better materials, there has been a great improvement in the quality of rails laid throughout this State during the past three years. Thus, in the three months, January, February and March, there were in 1912, 3,6[illegible] rail failures, the large number being due mainly to the severe Winter. In the same three months in 1913, when the weather was mild, the rail failures were only 1,1[illegible]. But for the same three months in 1914 when the weather was nearly as bad as in 1912, there were only 1,[illegible] rail failures, a most encouraging showing.

Another Fifteen-Cubic-Yard Dredge for the Panama Canal.—In our issue of May 9th, we illustrated the "Gamboa," the largest dipper-dredge ever built, which is now doing good work on the Cucaracha slide in the Culebra Cut, Panama Canal. This dredge, built by the Bucyrus Company, South Milwaukee, Wisconsin, especially for the Panama Canal, has a dipper of 15 cubic yards capacity. The second of the dredges, the "Paraiso," built by the same company and a duplicate of the "Gamboa," left New York Harbor in tow on April 26th, and will very soon be at work with the sister dredge, cleaning up what remains of the great slide.

Panama Canal Built Within Estimates of Unit Costs.—The engineers of the Panama Canal must be congratulated on the fact that they have built the canal within the original estimates of unit costs—something very rare in work of this magnitude. The estimate of cost of dry excavation for the Culebra cut was 80 cents per cubic yard, and it was actually built at a cost of 76.18 cents. The estimate of $8 per cubic yard for concrete in the locks was also above the actual cost, which was $7.14 per yard at Gatun, $5.89 at Pedro Miguel, and $5.37 at the Miraflores locks. Dredging in the harbors and entrances was estimated at 25 cents per cubic yard. The actual cost was 23.25 to 25.52 cents per cubic yard.

Trial Trip of the Largest Freight Locomotive.—The "Matt H. Shay," the large triple Mallet locomotive, built by the Baldwin Locomotive Works for the Erie Railroad, and recently illustrated in this journal, has made a trial trip over the Baltimore & Ohio Railroad from Baltimore to Philadelphia. The train load consisted of 53 coal cars carrying 4,012 tons of coal. The total weight of the whole train, including the locomotive, must have been about 6,500 tons. The train left Baltimore at 6:30 in the morning and reached Philadelphia at 4:30 in the afternoon, taking 10 hours and 20 minutes for the 99-mile trip. The engine weighs 423½ tons in working order, and its drawbar pull, working compound, is 80 American tons.

Successful Automatic Train Stop.—Six months of operation of the Miller automatic train stop on 24 miles of the Chicago & Eastern Illinois Railroad is reported. The system has been in place on one of two tracks on the section of the road in question, and 80 freight and passenger locomotives have been equipped with the necessary apparatus. On other sections of the road, some 30 miles have been equipped, and will be put in operation. The system includes a vertically-moving bar on the engine and a ramp on the roadway. Operation [illegible] conditions of sleet and snow, [illegible] "safety factor," is [illegible]

Science

[illegible] for Science.—A great hospital and medical school for St. Louis University is provided for in the will of James Campbell, filed in the Probate Court at St. Louis on June [illegible] last. The entire estate, valued at between $[illegible] and $40,000,000, with the exception of $1,000,000, eventually goes to the university "for a hospital for the care of sick and injured persons," and the "promotion of the sciences of medicine and surgery."

Extensive Scientific Investigations in Porto Rico, covering a period of four years, have been undertaken by the New York Academy of Sciences, with the financial co-operation of the American Museum of Natural History, the New York Botanical Garden, Columbia University, New York University, and the government of Porto Rico, and under the direction of a committee consisting of Profs. N. L. Britton, James F. Kemp, Franz Boas, C. L. Poor, and H. E. Crampton. The programme includes studies in anthropology, archeology, botany, zoology, geology, oceanography, etc. The reforestation of certain parts of the island is one of the practical problems to be investigated.

Relief Model of Hawaiian Craters.—A remarkable relief model of the craters of Kilauea, Kilauea-Iki and Keanakakoi, in Hawaii, has been made by George Carroll Curtis, of Boston, for the Harvard University Museum, to which it is a gift from Robert Sayles, curator of geology. Mr. Curtis spent three months in making a photographic survey of the region, establishing a network of flag stations and photographing from all of them. He states that this was "probably the most comprehensive survey of its kind yet made for the reproduction of a land-form type." It is expected that a copy of the model will be exhibited in the Hawaiian building of the Panama-Pacific Exposition.

The Windiest Region of the World of which we have any knowledge appears to be the coast of Wilkes Land, where Dr. Mawson's expedition recently spent two years. In his presidential address before the Royal Society of New South Wales, Mr. R. H. Cambage recently stated that Mawson's records at Adélie Land for 1912 showed an average wind velocity throughout the year of about 48 miles an hour, while velocities of 100 miles an hour were common. This surpasses even the records made on high mountains in other parts of the world, e. g., on Mount Washington, N. H., where the former meteorological station showed an average velocity of only 41 miles an hour during the Winter, and much lower velocities in Summer.

A Barometer Graduated in C. G. S. Units.—A well-known firm of instrument-makers in London has put on the market a new form of aneroid barometer, which was designed under the direction of Dr. W. N. Shaw, the head of the British Meteorological Office. The new instrument has several concentric scales. The outer is figured in centibars and subdivided to millibars. This scale can be adjusted according to the altitude of the place of observation, and then gives sea-level readings, such as are used for many purposes in meteorology. Along this scale is engraved the new nomenclature, "very low," "low," "normal," "high," "very high," in place of the time-honored but misleading terms "fair," "change," "rain," etc., which appear on nearly all existing barometers except those constructed strictly for scientific use. The frequency of occurrence of various readings, in days per year, at three representative English observatories, is also engraved on the scale, so that the observer can tell just how a reading compares with average conditions. The next inner dial is also in the centibar scale, but is fixed, and therefore gives the actual value of the pressure, unreduced for altitude. Lastly, two more scales give readings in inches and millimeters.

Ammonia and Nitrate in Rain.—Plant physiologists once believed with Liebig that a considerable part of the nitrogen utilized in the nutrition of plants was obtained from rain. Although this view has been abandoned, the amount of ammonia and nitrate in rain water has remained a favorite subject of investigation, and a great number of analyses have been made in various parts of the world. These have been brought together by Dr. N. H. J. Miller, in an article on "The Composition of Rain Water Collected in the Hebrides and in Iceland," published in the Journal of the Scottish Meteorological Society. The principal object of Dr. Miller's inquiry is to ascertain from what source these nitrogenous components of rain are derived. The old idea of Boussingault that atmospheric ammonia is derived from the sea, and the later one of Schloesing that tropical seas yield ammonia to the air, appear to be refuted by the fact that analyses of rain collected near the sea in tropical countries show less ammonia than is found at Rothamsted. Samples of rain collected systematically from various stations in the Hebrides and in Iceland, remote from sources of atmospheric pollution, contain ammonia and nitrate, but in very small amounts. In fact, the rain at the Butt of Lewis, in the Hebrides, contains less ammonia than at any other place in the world at which samples have been taken, being even less than was found in the Antarctic by the [illegible] expedition.

Automobile

Eliminating Glare from Headlights.—Still another solution of the troublesome problem of eliminating the confusing and dangerous glare from high power motor car headlights has been proposed, this time by the National Physical Laboratory of England. This body has been studying the question at the request of the London authorities. It proposes, briefly, to cut off the light beams coming from the upper right hand corners of the lamps, and in this way to provide a zone of darkness, if such it may be termed, so that an approaching driver will not be blinded. The right hand corner is chosen for the reason that in England the rule of the road is to the left. The arrangement provides ample light, yet appears to solve the glare problem.

A New Type of Differential Mechanism.—The motor car differential, that more or less weird mechanism which few but engineers really understand, always has constituted a knotty problem. By way of assuring that both rear wheels will rotate at the same speed on a straight road, regardless of traction obtainable at each, an inventor has perfected a new mechanism which differs from others principally in that it incorporates a plate clutch. The two plates of the clutch are connected one to either side of the divided rear axle and are held together by a spring. Thus when the car is traversing a straight road, the two halves of the axle must rotate at the same speed, for they are virtually locked together. But when the vehicle rounds a curve the clutch slips, permitting one of the rear wheels to rotate faster than the other. Obviously the mechanism has faults, for there must be considerable wear in the clutch; but the device indicates that attention is being given this problem.

Comprehensive Fuel Economy Test.—Tests of the fuel economy of motor cars by factories have not always been as convincing to the lay public as might be desirable to those who make the tests. Recently, however, the Franklin was subjected to a combination test and demonstration that cannot fail to prove convincing. Ninety-four dealers in Franklin cars, located in as many American cities, each fitted one of his six-cylinder cars with a tank containing one gallon of gasoline, and under the observation of disinterested persons drove the car until the fuel gave out. The tanks were certified, as was the quantity of fuel they contained. The average consumption of the 94 cars figured out at 32.8 miles per gallon of fuel. The greatest mileage obtained was made by a dealer in Milwaukee, Wis., who drove his car the almost incredible distance of 51.2 miles on one gallon of gasoline; the weather was fair. A dealer in Georgetown, Texas, drove 17.2 miles in a rainstorm.

Steam Car with Complete Condensation.—The difficulty of obtaining really efficient condensation placed what appeared to be an effectual bar before the steam automobile some years ago; mileage was limited because of the limited amount of water that could be carried. Now, however, this difficulty would seem to have been overcome in a car that has just made its appearance in Waltham, Mass. A double-acting, single-expansion steam engine with two cylinders measuring 4 x 6 inches is used. A fire tube boiler is used, with 158 feet of heating surface, and heat is supplied by a kerosene burner; it is said the car will run 10 miles to the gallon of kerosene. The condenser is the interesting part of the car. It is an ordinary honeycomb radiator, such as is used on gasoline automobiles for the cooling system. The exhausted steam is carried directly to the top of the radiator, whence the condensed water passes back through a Venturi mixing chamber to the water tank; the temperature of the water in the radiator never exceeds about 100 deg. Fahr. The car is capable of a speed of 75 miles an hour and will accelerate to 60 miles an hour on 800 pounds steam pressure, which is normal, in 15 seconds, from a standing start.

German Tests of Military Trucks.—The German army is engaged upon a series of tests upon military power wagons, and these comprise three different trials upon the road in the shape of endurance tests. The Berlin automobile corps is divided into two columns, and the first of these proceeds toward the Riesengebirge in order to make a circuit through these mountains, which will be a rather severe trial, while the second column goes to the southwest to carry out its programme in Bavaria. On the other hand, the automobile corps of Saxony are engaged in making an endurance test toward Switzerland and the Erzgebirge. Thus all the German heavy trucks are upon the road. Another endurance test of an interesting character was organized by the German Automobile Club for various automobiles as well as motor tricycles and the like, and as it took place in the Harz Mountains the cars had a very hard time, owing to a snowfall of two or three feet on the roads near Clausthal. Here the roads were also cut up by country sledges, so that this occasioned much difficulty. Cycle cars used chains and ropes wrapped around the tires so as to avoid slipping. However, the selected route proved to be too hard, so that an easier circuit had to be chosen. Most of the vehicles showed a good performance on this occasion.

How Inventors Propose to Save Men From Sunken Submarines

Detachable Buoyant Conning Towers and Their Uses

By Major H. Bannerman Phillips

THERE have been seventeen serious submarine accidents in the last ten years, of which eleven occurred to British vessels. The total number of lives lost in submarines up to the present date amounts to 211

With regard to the question of having special "lifting ships" in readiness to meet accidents, it has been pointed out by naval officers, first, that British submarines are stationed all round the coast—at such places as wide apart as Plymouth, Portsmouth, Harwich, Dundee, and Lamlash, as well as at places abroad, like Gibraltar, Malta, and Hong Kong, and that those attached to home ports go to considerable distances and dive in various places, so that it would be impracticable to have lifting-vessels standing by in all cases. Secondly, they say that in scarcely any known instance would a lifting ship have been of assistance in saving life, if it had been available, and that in all cases of accident where life has been preserved, it has been due to the efforts of the crew themselves without any outside assistance

On the other hand, it has been said that officers and men of the submarine service have not hitherto attached much importance to life-saving appliances as applied to the particular vessels for which they are responsible. They have said that the air-lock and helmet might enable men to escape if circumstances were propitious, but that these same circumstances are not likely to be propitious in the case of accidents On the contrary, they know full well that, if anything serious happens to a boat, the crew are almost certain to lose their lives, and they accept the risks as part of "the day's work"

There is no doubt that the accidents due to what may be called true submarine risks, that is, mishaps which are not caused by external interference, such as collisions, and are due to causes and circumstances inherent to the system, are steadily on the decrease, and this satisfactory result must be ascribed to the constant improvements in construction and equipment For instance, in the "A" class of submarine in the British service (13 boats) 25 lives have been lost by collision, and 32 by foundering and explosions. In the "B" class (11 boats) 15 lives have been lost by collision—none through other causes In the "C" class (38 boats) 13 lives have been lost by collision and one by explosion. In the "D" class no lives have been lost so far; in the "E" class there has been one accident from explosion, which was responsible for the loss of three lives

Whatever the cause of the mishap to the "A-7," there is apparently no known reason to suppose that the conning-tower was damaged. It doubtless remained clear of the sand and mud in which a portion of the vessel was imbedded, and under such circumstances, although the airlocks and helmets may not have been of any use, owing to the depth, if the conning-tower had been detachable as a whole apparatus, water-tight and provided with air-storage, which would rise on being set free from the hull, there would have been some chance of rescuing the crew, provided they were not killed by the same cause which prevented the rising of the submarine itself. One such apparatus has been designed and patented by Mr. E. J. Castle, a retired draughtsman from His Majesty's service, and another by Mr. G. Fitzhardinge Rose of London.

Mr. Castle's idea is, to use his own words, referring to the illustration of the invention, as follows:

"To fit two towers, 5 feet in diameter, and about 5 feet 6 inches deep, constructed of steel, well strengthened inside with brackets and steel angles, and placed on the water-tight bulkheads By this method, in the event of any one compartment getting waterlogged by escaping into an unflooded one, the crew can release themselves from the vessel by opening the escape scuttles on either side of the bulkhead in submarine and towers, and closing both when inside (making the vessel intact) and detaching them by means of clips. In the case of the "Lutine" (French submarine) where all the crew were lost, some escaped from a flooded to an unflooded compartment, and lived for an hour, but there was no detachable tower or other device by which they could get out. By my method escape is afforded from three compartments for about 8 to 10 men in each. A small hydraulic is provided for the purpose of exerting an upward pressure if required.

"On the manhole cover in each tower is a signal apparatus fitted with a cork buoy, which, on being released from inside by turning back the screw, rises to the surface, taking with it a fine flexible steel wire line; communication can be made to those inside the towers and at the surface, and will show the position of towers. The towers [illegible] the deck, but they can be fitted at [illegible] resistance if required.

"A flexible wire is stowed in a [illegible] resting upon it, the wire passing [illegible] have a vertical pull in the event of [illegible] The alarm is located below the cover [illegible] purpose of keeping the towers stable [illegible]

"Although the fitting of chambers [illegible] few have been patented, this plan is [illegible] if tried would be found to be practical [illegible] purposes, and would not weaken the [illegible] time giving good chances for the crew [illegible] at great depth. There would be a [illegible] ent [illegible] age in case of collision, but still the vessel would continue to be [illegible]."

Mr. Rose's invention, pictured on the cover of this issue, includes a submarine lifeboat and buoy. The lifeboat consists of a cylindrical chamber some 8 feet in diameter, held under normal conditions within a water-tight compartment by means of a stout screw carried through the base. At one spot within the water-tight compartment is a secondary chamber containing a buoy attached to a length of wire. On an accident happening to the submarine, the crew enter the water-tight belt, and, sealing the door behind them, pass on to the inner cylinder. One stays behind sufficiently long to release, by means of a bevel gear, the buoy in the smaller chamber. The buoy rises to the surface at once, and indicates the whereabouts of the submerged craft. As soon as the crew are within the inner cylinder and the doors are shut, the cylinder is released from its contact with the body of the submarine by the unscrewing of the grip beneath the floor. If the compartment in which the cylinder rests has not been damaged, the cylinder at once rises to the surface by its own buoyancy. There is an electric light in the conning-tower and an apparatus for firing distance-rockets, so that, whether by day or night, attention can be called to the position of the floating cylinder, with a view to obtaining help and avoiding collision. In calm weather, a collapsible boat can be launched through the conning-tower, to enable help to be sought from the shore or from passing vessels, or to locate the search-vessels which might be sent out to look for the submarine. Provision has been made, however, for the contingency of such damage to the submarine as may prevent the lifeboat cylinder from rising to the surface and cause the detention of the crew at the bottom of the sea. Within the cylinder are two other compartments, which can be opened to the sea by a convenient gear. These contain buoys which, rising to the surface, carry with them air-tubes, electric light and telephone wires. The buoys are so shaped that they ride on the waves and keep a free air-vent, and on the exhaust-pipe of one buoy there is fitted a siren. By pumping fresh air in through the other buoy and the foul air out again through this one, the siren is worked, and the attention of passing or search-vessels called to the spot. In proximity to the [illegible]

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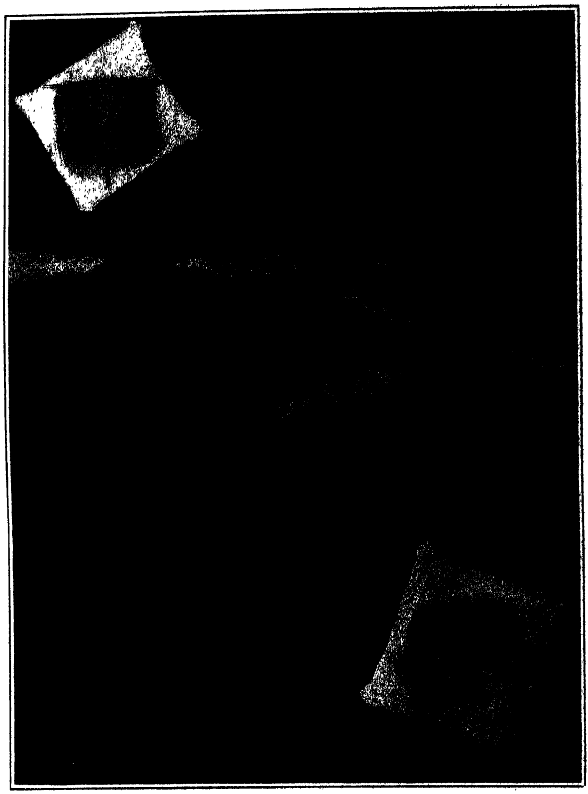
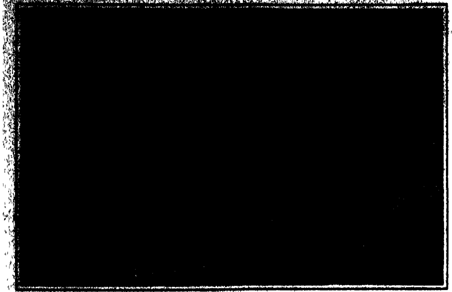
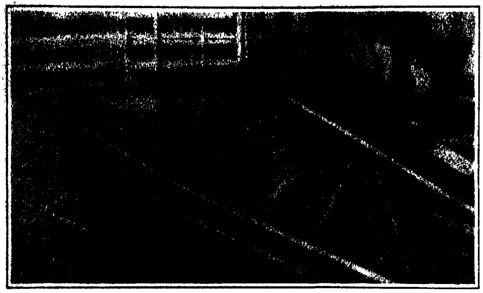


The small drawing in the upper lefthand corner shows the watertight escape scuttles which are fitted to each compartment, as well as to the towers The detail drawing in the lower righthand corner shows the signal apparatus, which is located on the manhole cover in each tower. The whole is fitted with a cork buoy, which on being released, rises to the surface, taking with it a fine flexible wire, by means of which it is possible to communicate telephonically with those imprisoned in the towers Beneath the cover is an alarm.

The Castle device for saving men from sunken submarines.



Over the skeleton is laid one skin of ¼-inch spruce. On the bottom of the forepart two skins of ¼-inch spruce are screwed to the floors.



The structure of the hull, here shown upside down, comprises the usual stringers and ribs to give it strength and form, as in standard boat architecture.

The Rodman Wanamaker Transatlantic Flier

Glenn Curtiss's Masterpiece in Flying Boats

By Our Staff Correspondent at Hammondsport

Illustrated with Photographs Copyrighted by H. Benner

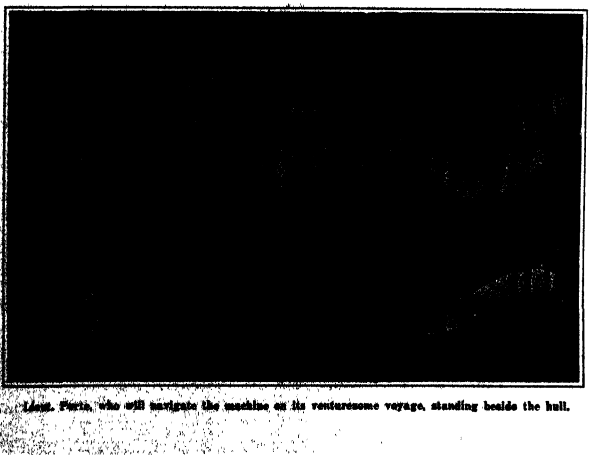
THE Wanamaker transatlantic flier, publicly announced as a serious project early last February, in Mr. Rodman Wanamaker's letter to the Aero Club of America, is now approaching trial as a splendid reality. It represents, as did the great Deperdussin racing monoplane which amazed and delighted aero sportsmen in 1912 the capital achievement of a magnanimous and liberal patron of aviation, a bold, original, and severely practical aeronautical designer and manufacturer, a skillful, sagacious, and fearless pilot, all striving together for the same great end—in the present case, the joining of the hemispheres by a new route of less than one day's sail. The third man of this trio, Lieut. John Cyril Porte, R. N., of England, has been Mr. Curtiss's industrious colleague in working out the details of the huge aeroplane, and in devising the means to navigate it with precision and security.

The original plan, which for the present has been superseded by one requiring less unfamiliar construction, contemplated a tractor biplane with one direct-connected 200 horsepower engine, a whale-shaped or stream-line fuselage with detachable running gear, provided with a water screw for voyaging in the sea in case of necessity, and a closed hood and water-tight compartments for the safety of the two aviators. This craft was to rise from St. Johns, Newfoundland, leaving behind the chassis, soar aloft two miles, take the permanent easterly wind of 50 miles an hour, and, with her own speed of 60 miles, sweep straight to Ireland without a halt, at a speed of 110 miles per hour, and make the entire journey in some 18 or 20 hours.

How the Original Plan Was Changed.

The original plan would not permit of rising from midocean. It was therefore decided to employ, in the first cruise across the Atlantic, an enlarged Curtiss flying boat, capable of carrying two passengers and supplies for twenty-some hours, and, of course, capable of landing and rising at will in mid-ocean in favorable weather. In this later plan no attempt to use the upper stream of the atmosphere would be made. The start would take place when the weather forecast, especially made for the occasion by the U. S. Weather Bureau, should seem most auspicious, and the flight would be made over the most direct and practical route, now high now low, as circumstances should dictate. The transatlantic flier, now receiving its final touches in the Curtiss factory, is by far the largest aeroplane ever built in the United States, and one of the very largest in the world Sikorsky, in Russia, and Collieux, in France, have machines—the former a land, the latter a water craft—which can carry larger loads; but they were not designed for such long distances, and could not carry sufficient fuel to attempt a flight across the ocean Sikorsky's machine, for example, has motors aggregating 400 horse power, and would need two tons of supplies to clear the Atlantic securely without stop

The fore part of the hull, forming the storage-room, is shaped like a slipper; the after part is shaped like the rear end of a whale.



Lieut. Porte, who will navigate the machine on its venturesome voyage, standing beside the hull.

The Wanamaker craft is a biplane flying boat, measuring 72 feet from wing tip to wing tip of the top plane, and 46 feet in the bottom plane; 38 feet from prow to the end of the vertical rudder, spreads about 500 square feet of wing surface, and weighs complete, with two men and supplies, about 5,000 pounds. The wings are 7 feet wide, and have a gap between them of 7½ feet The hull is 34 feet long, [illegible] feet in the beam 6½ feet deep from keel to top of hood, and generally of the Curtiss flying boat pattern, but with a closed hood provided with numerous small celluloid windows over its top and around its front and two sides, on the level of the eyes of the aviators sitting on the bench in the fore part of the cabin

Some of the Craft's Interesting Features.

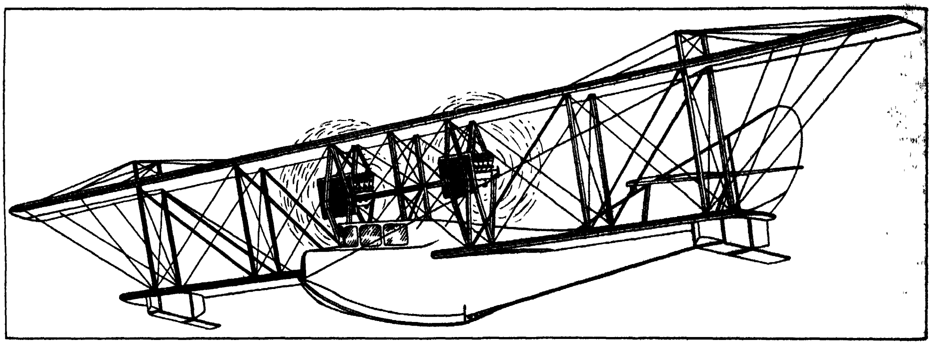
The fore part of the hull, forming the storage room and pilots' cabin, is shaped like a slipper, the rear part is shaped like the rear of a whale. The whale-like stern carries the horizontal and vertical control surfaces. The craft is propelled by two engines mounted midway between the planes, on either side of the hull, each directly connected to its individual propeller. The control system differs from the usual Curtiss type only in the manner of working the ailerons. On account of the great force required for this, the ailerons are worked with the feet. Thus pushing with the right foot elevates the right aileron, thereby depressing the right wing, and *vice versa.* When the boat runs quickly along the water, it gradually rises, skates on the sole, then on the heel of the slipper, then soars aloft, the whole craft beaming scarlet, to be more clearly visible at a great distance. Such is a general description of the more striking features of the strange vessel that is to take the modern Columbus from the New World to the Old World.

The structure of the hull is fairly indicated in the accompanying illustrations. Its skeleton comprises the usual stringers and ribs, to give it strength and form, as in the standard boat architecture. Over these is laid one skin consisting of ¼-inch spruce laid lengthwise, with slight upward spiral toward the stern, and fastened on with brass screws. On the V bottom of the slipper-shaped fore part of the hull, two skins of ¼-inch spruce are screwed to the floors, or V cross-members, with blind holland laid between skins, and saturated with marine glue. The entire hull, thus framed and covered with ¼-inch spruce, has placed over it two layers of blind holland, the under one laid lengthwise, the next one wound on spirally, both brushed with marine glue, ironed hot, and finally painted. The prow is sharp vertically—a new departure—to cleave the waves and to avoid shipping water; the stern is oval, terminating in a vertical edge to which the rudder is hinged.

The interior of the hull aft the step has four water-tight compartments separated by vertical cross-partitions of three-ply birch veneer 3 millimeters thick. Before the step is the large compartment, or cabin and supply room. Its rear part contains three gasoline tanks having an aggregate capacity of 1,500 gallons, all of circular section and made of tinned steel. From these tanks the fluid is pumped up to the auxiliary or feed tanks, from which it runs by gravity to the engines as needed. In the forward part of the cabin, a bench with a back stretches quite across the boat, and has a 3-inch deep corduroy cushion to make the aviators comfortable. Behind this seat is a mattress whereon one at a time can recline or sleep, if advisable. Before the seat are the navigating instruments and the usual two-wheel Curtiss control.

The Wings of the Machine.

The over-all dimensions of the wings have been given. Their contour is that of the most efficient practical wing resulting from the systematic aerodynamic investigations conducted by the British government in its aeronautical establishment. The contour measures 7 feet in chord, 6 inches in depth of camber of its upper side one third back from the leading edge, is nearly plane or straight underneath, and dips sharply down at the forward edge, like the edge of a bird's wing, or like the wing patented by Phillips in England thirty years ago. The rear edge of the wing is somewhat flexible. Two main spars in each wing, of I-section, run throughout its entire length, and each is placed about 18 inches from the nearest wing edge. The front edge of each wing is formed of a rounded beam, approximately crescent-form. Practically all the wing woodwork is of spruce, and the internal structure, as a whole, is trussed with piano wire, according to standard good practice. The whole wing and tail surfaces are covered on both sides with a light Japanese silk, and varnished several times to make it air-tight. Near the hull the wings are so strongly ribbed and covered with veneer as to bear the weight of a man, but farther out they are built of ordinary strength. Heavy stream-line posts and heavy steel cables truss together the upper and lower planes.



The craft is a biplane flying-boat, measuring 72 feet from wing tip to wing tip of the top plane and 46 feet in the bottom plane, and 38 feet from the prow to the end of the vertical rudder. The wing spread is about 500 square feet. The machine will be driven by two 90 horse-power eight-cylinder engines.

The upper planes jut about 18 feet beyond the lower ones at each side, and in this over-shoot they are cut away to the rear of the back spar, so that the ailerons may be attached there. These measure 15 feet long by nearly 20 inches deep, and turn only upward.

The engine section of the wings is peculiarly massive in structure and appearance. The lower wing spars pass through the hull, like floor joists in size, and are firmly lashed to the interior with strong ash verticals joined to them with angle iron. Each engine is supported on a massive wooden frame, sustained front and rear by a double post whose two parts are spread out, diamond-shape, and trussed like a crutch, for strength, and worked to stream-line form. The distance between the two propeller shafts is 8 feet 8 inches. The whole engine section is trussed with heavy cables, has a massive brace running obliquely down and forward into the cabin, and, as a whole, presents more the appearance of a pavilion for resisting storms than a craft to soar on thin air.

The Engines of the Flier.

The two engines are of the best Curtiss O. X. make, each of 90 horse-power, eight-cylinder water-jacketed, and running at 1,200 revolutions; they weigh, together, 690 pounds. Their radiators weigh 62 pounds each. Each presents 2 square feet of front, contains ¼-inch tubing nearly 3 inches long, and the radiator of each exposes 100 square feet of cooling surface. In the 30-hour continuous test, held the second week in June, the engines consumed together 288½ gallons of gasoline and 10⅝ gallons of oil, weighing in all about 1,800 pounds. The radiators will be placed before the engines, and the oil tanks just behind the radiators, all midway between the upper and lower planes. Bosch magnetos and carbureters complete the power plant.

The tail unit, mounted on the rear of the hull, comprises an adjustable tail plane, of some 50 square feet surface, and semi-circular in form, to the rear edge of which is hinged the elevator, of the same area; also a fixed vertical triangular fin to whose rear edge the vertical rudder, of some 20 square feet area, is hinged.

The propellers may be the ordinary two-bladed wooden screws, of 8 feet diameter and 5 feet pitch, or some new kind not yet made public.

Lieut. Porte, after receiving the Wanamaker flier from Mr. Curtiss, at St. Johns, Newfoundland, will be in command of her during the over-sea voyage, aided by an assistant who is a skilled aviator expert in knowledge of the Curtiss motor. Mr. George Hallett will act as chief aviator, while Lieut. Porte will be the responsible navigator in authority. Mr. Hallett will be dropped at the Azores, and John Lansing Callan, one of the instructors in the Curtiss flying school, will there board the machine and complete the trip with Lieut. Porte. Mr Hallett and Mr. Callan will relieve Lieut. Porte at the controls.

Space will not permit a description of the navigating instruments and the preparations for safety and success during the voyage. The instruments have been carefully studied, some being new to the art; arrangements have been made for assistance, if needed, *en route*; the exact route itself, and the nature of the difficulties to be met during the daring voyage, have received due attention. It is to be hoped that these details, many of them still secret, have been as well provided for as has the construction of a motor qualified to sustain a continuous voyage of a day and a night—and that the final test of Lieut. Porte's navigating provisions will be as felicitous as the 30-hour test of those stanch Curtiss engines.

Regulations for the Round-the-World Flight

REGULATIONS governing the [illegible] aerial race of the Panama-Pacific International Exposition have been submitted to the Aero Club of America.

The race, for which $150,000 will be awarded as prizes, will start from the Panama-Pacific Exposition grounds in San Francisco on May 15th, 1915. It must be completed before noon of December 4th, 1915. Licensed pilots of any country may compete, [illegible] kind of aircraft may be used. The entries [illegible] ceived between November 1st of this year [illegible] of next year. An entrance fee of $500 [illegible] pany each entry.

All competitors must pass over the course in [illegible] erly direction, and controls will be designated [illegible] exposition authorities, at which each competitor [illegible] alight in the order named. Each flier will [illegible] log book and instruments to the officials [illegible] each control. Each competitor may follow any route he chooses from one control to the next, but supply stations and patrol service will be provided along only one route, the one considered most feasible.

The distance between two controls must be traversed in the same aircraft. A stop may be made anywhere, however, for repairs, even to the extent of installing new motors, and at any control the competitor may abandon the machine he has been using and go on with another one, if it be of the same class of aircraft as that in which he started the race.

Of the $150,000 prize money, $100,000 is to go to the flier finishing first, $30,000 to the second, and $20,000 to the third, provided the flight is made within 121 days. If the first flier fails to make his way around the world within 121 days, but does it on or before December 4th, the first prize will be reduced $1,000 a day for each day more than the 121 required to finish. Reductions are to be made from the second prize at the rate of $300 a day, and for the third prize at $200 a day.

If none succeeds in the flight, but one or more do it all except across the Atlantic and Pacific oceans, or any other body of water, there will be a reduction of $20 from the first prize for each nautical mile not traversed; $6 from the second prize; and $4 from the third. These deductions will be in addition to those for time over 121 days.

Arrangements are made for third, fourth, fifth, sixth, and seventh prizes in case the deductions from the first, second and third prizes make them possible. No prize shall be paid to any one who does not finish the race before December 4th. Fliers may carry aids or passengers and may change them *en route*, but the pilot of record must be in control at all starts and alightings.

Another Zeppelin Accident

ANOTHER of the Zeppelin airships of the German army, the "Z 1," was badly wrecked near Diedenhofen, on June 13, according to press dispatches. While trying to effect an emergency landing the air cruiser broke at right angles behind the rear car. A lieutenant was injured.

The accident occurred during a flight from Cologne to Metz. The "Z 1," with a military crew on board, ran into a rainstorm and the commander decided to descend. When the air vessel was within a few yards of the ground a sudden gust of wind dashed it violently to earth and it broke virtually in two. The airship can probably be repaired.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Color Music

To the Editor of the SCIENTIFIC AMERICAN:

My attention has been drawn to the SCIENTIFIC AMERICAN, dated February 21st, pages 163-170, in which appears an illustrated article entitled, "An Organ on which Color Compositions are Played: A New Art of Color Music and its Mechanism," by John W. N. Sullivan, and I have read this with very considerable interest.

In this connection I might mention that Prof. Rimington and myself have been workers in this sphere, unknown to each other, and I registered my patent in the Commonwealth of Australia on January 22d, 1912. I have since obtained a patent in Great Britain for "Color Music," dated December 28d, 1912, No. 29615/1912.

ALEC B. HECTOR.

Sydney, Australia.

Sun-power Plants Not Visionary

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of May 23rd of this year appears an article headed "Energy from the Sun," in which you have expressed yourself too pessimistically.

The only invention claimed in the Egyptian sun-power plant is the *generating of steam by the heat of the sun*, and only the amount of steam generated should be taken into consideration.

Unfortunately, there were serious mistakes made in the shop work of the construction of the engine and pump, which did cut down the amount of pump horse-power delivered to 19.1. These mistakes would have been avoided had we tested the engine and pump at the works before sending them to Egypt, and will not occur again.

The sun heat absorbers generated steam enough to give *an average* of 50 brake horse-power for ten hours a day, as will be seen if Mr. Ackermann's tests are read by taking into consideration only those tests which were made at 15 pounds absolute (the pressure at which the sun heat absorbers are to run).

We are, therefore, right in calling this steam-generating plant one of 50 horse-power instead of 19.1.

Now a careful estimate by an experienced builder of power plants shows that the steam-generating portion of this plant can be duplicated and erected in the tropics when done on a manufacturing scale by special machinery, for the sum of $7,800, or $156 per brake horse-power.

It is entirely true that this is considerably more than the cost of the best modern steam plants of equal power, but it must be borne in mind that when this plant is once erected, it not only furnishes the required power *perpetually*, but may be said to "*raise its own coal*," and this puts the sun-power plant in an entirely different class, and justifies most careful thought.

The plant is so constructed that it has a very long life and requires little repairs, and is, in fact, very simple.

It is true that sun-power plants do occupy a great deal of ground, but ground in those portions of the tropics where we at present intend to confine ourselves has practically *no value*, and therefore it is merely a matter of cost of construction, maintenance, and cost of running.

Maintenance and cost of running is a little less than that of an equal power coal plant, and therefore the comparison narrows itself down to a matter of interest on the increased investment, and careful figures show that, taking this into consideration, we can compete with coal at $2.50 per ton in those portions of the tropics where the sun shines practically throughout the year.

For the next ten years or so we expect to confine ourselves to irrigation in those regions of the tropics where coal is $15 per ton and above, and where we can count on at least 90 per cent of sunshine during the days of the year, and there we *know* our present sun-power plants will effect great savings. This field alone is large enough to give us all the work we shall be able to handle for some ten years to come.

We have devoted seven years of time and have spent nearly a quarter of a million dollars in investigating every possible phase of sun power, and firmly believe we have solved the problem of utilizing, for the benefit of the human race, this greatest of all natural forces, and ask all engineers to look at this great problem from all sides, and very carefully, before putting it into the visionary class.

The problem of flying in the air has been nearly solved, but only fifteen years ago it was called a dream of the far-distant future.

Up to the present time in all the history of the human race, only three natural forces—wind, water, and fire—have been utilized, and it is about time that all thinking men should seriously occupy their minds with utilizing the greatest, the cause of them all—the sun.

Certain it is that it must be done within the next one hundred years or so, or else we shall have to revert to barbarism, because eventually all coal and oil will be used up.

Sun power is most logical. We know the sun is the central power-house of our universe, and we should, therefore, attack most seriously the problem of connecting ourselves with the sun *direct*.

Please do not take our attempt as the final. Natural forces are not entirely conquered in a few years. The first steam engine was not a quarter as efficient as our present ones. We know quite well that we have only made the beginning, and that the sun-power plant of ten years hence will be at least *twice* as efficient as the one we have just tested, and that improvements will be made every year, but someone must make a beginning in a practical and *public* way, and we have done this to the best of our ability.

FRANK SHUMAN

London, E. C., England.

The Ease of Variable-star Observing

To the Editor of the SCIENTIFIC AMERICAN:

Your issue of April 4th, 1914, contained an excellent article, "The Attractions of Variable-Star Observing," by Dr. Edward Gray. It savors somewhat of presumption to attempt to supplement Dr. Gray's word, but it struck me possibly the Doctor had not sufficiently emphasized the ease with which this work may be taken up by the beginner. It occurred to me, therefore, that the very fact that Dr. Gray is one of the pioneer amateur observers of variable stars, while I am but one of the very "new beginners," might place me almost in a better position to demonstrate to other beginners how easily they can make a start at this fascinating form of useful observing. A bald recital of my own recent experiences may perhaps prove my point.

The possession of a good small telescope (a 3-inch objective) had for about a year and a half been a source of great pleasure. But "sight-seeing," even in the heavens, grows monotonous, and the trip to the roof of a New York apartment house, my only "observatory," became more and more laborious. Finally, the telescope remained for weeks at a time untouched—a stagnant investment. It was but a few months ago, having but a vague idea of what a variable star was, that I wrote to the secretary of the American Association of Variable-Star Observers, Mr. William Tyler Olcott, Norwich, Conn., asking for information as to how to begin, and for help in beginning, variable observing. Promptly, I received a most explicit reply, together with a number of variable charts, and that very night, with no difficulty, picked up several fields and recorded several observations. This certainly shows that a start is not hard to make, even for the veriest tyro. A letter to the Harvard College Observatory brought an equally prompt response in the form of some of the observatory bulletins describing how best to make observations, accompanied by several more charts. Since then the secretary of the association has, from time to time, in fact, every few days, added charts to my list, until this comprises well over one hundred different ones. As a result, my telescope, far from standing idle, finds every clear night a definite, interesting, and constantly new work to do

My equipment is of the simplest; a 3-inch telescope, without even a "finder"; a pair of field-glasses, a star-atlas, price $1, and the charts supplied with no cost to me. Many observers have telescopes mounted equatorially, and having "circles," which enable them to "set" on a variable field immediately. For them, I have almost a feeling of pity—they lose the delight in "sweeping" a region in search of a variable-field and at last locating it, which method, although it often requires more time, bears with it a joy much akin to the "Easter-egg hunting" of our childhood. The feeling that one is "growing warmer," the sudden recognition of some small configuration of stars marked upon the chart, and the final most satisfactory "*There's* the variable," can never be experienced by the more scientifically equipped.

Using, by necessity, this less scientific, but I insist this more sporting, method, the first move is to mark on the star-atlas the position of the variable, or, rather, the variable-field, this being always given on the chart itself. The relation of this position to the naked-eye stars shown on the atlas enables the observer immediately to sight his instrument at *about* the correct position, and then a few moments' careful "sweeping" identifies the variable. Surely nothing can be much simpler. It is true that sometimes a field will prove most elusive, but care and patience always are successful, and the pleasure in finally triumphing is perhaps even increased by the difficulty. It is also true that, after but very little practice and a consequent knowledge of the positions of the fields, a variable is found at the first sight, and the sweeping search is unnecessary.

Once in the field of view, it requires but the most brief experience to compare with good results the brilliancy of the variable with the various standard comparison-stars, whose magnitudes are marked on the chart. Some care must be used in making estimates of deeply-colored stars, which often appear too faint upon first sight, and whose true brilliancy is not recognizable until their light is allowed to "sink into" the eye; but, at the most, three or four minutes is ample time to obtain an estimate of magnitude often of remarkable accuracy.

The use of the field-glass becomes practical in many cases where variables wax high enough in magnitude to make the greater light gathering power of a telescope unnecessary. I have often found my field-glass available as a substitute for a "finder," which my telescope lacks. Where, particularly in our hazy New York skies, it is impossible to see with the naked eye the fainter stars marked on the star-atlas, especially when these stars are included in the variable-field, the field-glass can be of great assistance.

Dr. Gray pointed out most clearly the fascination and the real value of this variable observing, but it does not seem out of order to reiterate that it is practically the only steady, useful work which amateurs can do with small instruments. It is gratifying to know that the work is much appreciated by the Harvard College Observatory, the headquarters in this country for this branch of astronomical research. Recently, the director has placed in the hands of the secretary of the association a large number of variable charts for distribution among the members of the association, and in his latest report the work of the association is spoken of in a most complimentary manner.

It is to be hoped that the membership of the association will continue to grow in numbers as rapidly as it has during this past year. More observers are needed—there cannot be too many—and anyone possessing an instrument with an object-lens of two inches or over will certainly find the work well worth undertaking They may be sure, also, of a warm welcome to the ranks of the variable observers, and of obtaining all the assistance which lies in the power of the members to give.

EDWARD W PUTNAM.

New York City.

A Chance for Some American to Build an Iron Foundry in Poland

ONE of our European subscribers sends to us the following inquiry.

"We intend to erect a steel and iron plant in this country, and we request you to indicate what firms would be willing to consider our needs, the following general specifications to be observed.

"1. The iron plant is to have a yearly production of about 11,500 tons. Of this output 6,560 tons are intended for the production of water collar and bowl pipes; 1,640 tons for fittings to these pipes, and 3,300 tons for casting various machine parts, such as transmission wheels, gears, parts of water turbines, aqueduct piping, special machinery for sugar and other plants.

"2. The steel foundry is to have an annual production of about 6,600 tons. Of this output 3,300 tons will be used for producing blocks for hydraulic presses and hammers, rollers, etc., and 3,300 tons for various steel castings, such as railway car wheels, parts of railway cars and locomotives, gear wheels, bridge members, parts for high-pressure steam engines, rollers, and sundry small castings.

"3. In order to carry on the operations described, we intend to erect one Siemens-Martin furnace having a capacity of about ten tons of metal and shops for general work in which the following departments are to be found: *a*. Manufacture of water turbine parts; *b*, manufacture of water pumps, *c*, railway car wheel shop; *d*, gear wheel shop for turning out cylindrical and conical gears as well as Wuest's and Cytroen's gears."

The SCIENTIFIC AMERICAN will be pleased to place American manufacturers and engineers in communication with our correspondent.

An Honorary Degree Conferred on the Commissioner of Patents

HON. THOMAS EWING, Commissioner of Patents, received the honorary degree of Doctor of Laws from Georgetown University. Dean Breeden in conferring the degree characterized the Honorable Commissioner of Patents as "a man of action who attained such eminence as drew to him widespread attention, and deserving of the high post of public office"

A French Entry for the Transatlantic Flight

THE French aviator, Auguste Maicon, has been entered for the *Daily Mail's* transatlantic flight for a prize of $50,000 by Paris Singer, a wealthy American resident of Paris, at his own request

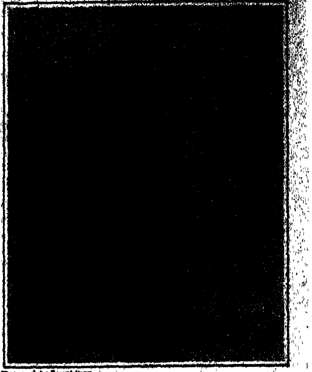
Mr. Singer, who employs Maicon in his "aeroplane stable" at Cap Ferrat, will finance the venture.

The Challenger "Shamrock IV" Under Sail

New Yacht Easily Outsails Fastest British Cutter in Moderate Winds

Photograph by Record Press

Deck view, taken from masthead.



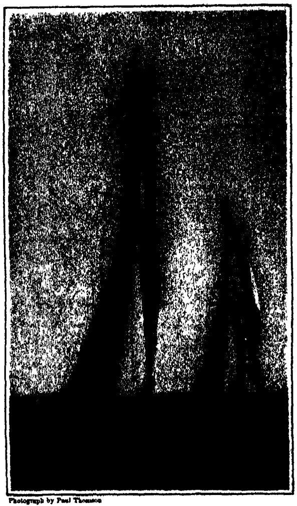
Photograph by Record Press.

Elaborate trussing of "Shamrock's" mainmast.

NOT until "Shamrock IV" meets either the "Resolute" or "Vanitie" next September on the Sandy Hook course, will anybody, not even the men who designed the boats, have the least idea which is the faster of the two. There is no question whatever but that both Herreshoff and Gardner have turned out, in the 75-foot class, two boats which could easily save their time allowance over "Reliance," and, under certain conditions of wind and weather, such as light airs and a tumbling sea, might beat the 90-foot yacht with time allowance excluded. If proof of this were wanted, it is sufficient to point to the first of the three trial races held recently over the Sandy Hook course, in which the winner, the "Resolute," made the thirty miles to windward and leeward in the record time of 3 hours, 15 minutes, and 41 seconds. To appreciate the significance of this, we must remember that the next fastest time, 3 hours, 24 minutes, 39 seconds, made by the 86-foot "Vigilant" against "Valkyrie II," was done under the favorable conditions of a strong wind of about twenty knots; whereas "Resolute" made her record in a wind which varied from say ten to fifteen knots in strength. At the present writing, "Resolute" seems to have taken the measure of "Vanitie" going to windward, for she beat her in this particular race 3 minutes and 49 seconds, in the fifteen miles to the outer mark, and in the third race she beat "Vanitie," in ten miles of windward work, by 4 minutes and 1 second. On the other hand, "Vanitie" is considerably faster than "Resolute" in reaching, for in the second race, on a reach of ten miles, she outsailed the "Resolute" by 4 minutes and 20 seconds.

But what about "Shamrock IV"? Has Nicholson succeeded in getting the same speed out of a 75-footer as we have on this side of the water? The only measure of her speed is the old "Shamrock," also a 75-foot yacht, with which Sir Thomas Lipton made a pretty clean sweep for some years past in the 75 foot class in European waters.

It should be explained that this "Shamrock" is not one of the old challengers for the cup, for each of these went to the scrap pile long ago. The "Shamrock" was built in the new 23-meter (75 foot) class several years ago, under the International Rule, the object of which was to provide a fast racing yacht which would be of strong construction, habitable, and suitable for cruising purposes if it were desired so to use her. This rule was drawn with the object also of cutting out the long, full overhangs and the shoal skimming dish hull and keels of exaggerated draft, which characterized "Reliance" and to a lesser degree, "Shamrock III." The rule tends to produce a boat similar to "Resolute" and "Vanitie," and it is probable that the underwater form of the old "Shamrock" lies somewhere between that of these two boats. At the same time it must be remembered that, since "Shamrock," under the International Rule, had to be built to Lloyd's requirements as to scantling, etc., she is probably much heavier in build than either of our cup defenders, and therefore, presumably, she is not so fast. On the other hand, the "Shamrock" holds the record for speed for a 75-foot cutter, and indeed, as far as we know, for a cutter of any length over a 48-mile course. This achievement she put to her credit in a hard-sailed race over the inside course off the Isle of Wight, in which she covered just under 48 miles in exactly 4 hours, which means that she must have maintained an average speed of slightly under twelve knots.



Photograph by Paul Thompson

The 23-meter "Shamrock" (right) trying out "Shamrock IV."

This race, of course, was sailed in a very strong wind, and, thus far, in the trials between "Shamrock" and "Shamrock IV" there have been no tests of exactly this character. On the other hand, if the cabled accounts are correct, Lipton's new yacht defeated the old "Shamrock" over a triangular course of fifteen miles by 9 minutes and 4 seconds. The most significant fact about this race is that she beat the old boat 6 minutes in five miles of windward work, or over a minute a mile. Over a windward and leeward course of fifteen miles, out and back, this would mean a gain of over 18 minutes at the outer mark.

These results are so extraordinary, achieved as they were against a well-proved boat of the same class and same length, that we feel inclined to doubt the accuracy of the timing or the distances. Nevertheless, it is well established that "Shamrock IV" is a remarkably successful yacht in working her way out to windward. Also, she is said to have beaten the old "Shamrock" almost as much as a minute a mile when running down the wind in a light breeze. On a reach, however, she does not show much superiority; and it is on this account, doubtless, that "Shamrock IV" is to be given a double head rig (jib and staysail) in place of the single jib which she has hitherto carried.

To our mind the most significant fact regarding Lipton's new boat is that, in light airs she has not shown much superiority to the old "Shamrock," this being due to the fact that, because of her full body and unusually long keel, her wetted surface must be very large for a 75-footer, and as the wind lightens in strength, the area of wetted surface becomes a most important factor. In spite of her large sail area, it is probable that the ratio of sail area to wetted

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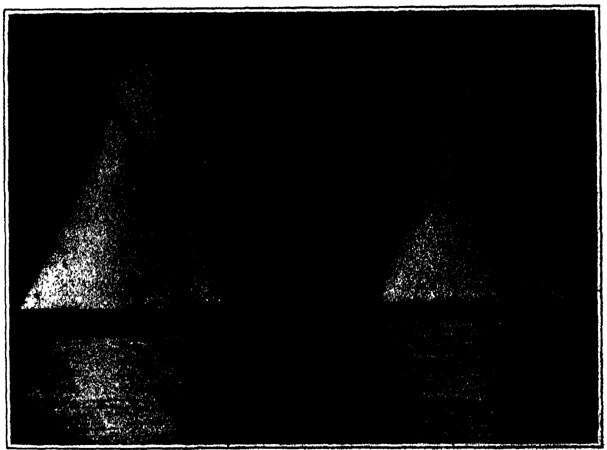


Photograph Copyrighted by International News Service

Lipton's 23-meter (75-foot) "Shamrock," at left, and "Shamrock IV."

Note the lofty rig of the challenger, her straight sheer, and low freeboard.

Repair of Los Angeles Aqueduct Siphon

Collapsed by Atmospheric Pressure; Restored by Hydraulic Pressure

By Burt A. Heinly

A PECULIAR accident which is at once a striking illustration of the terrific force of atmospheric pressure and at the same time the counteracting effect of hydraulic pressure was that which brought the rupture and repair of the Antelope Valley steel inverted siphon of the Los Angeles aqueduct, in the period extending from February 20th to March 18th, 1914.

The Los Angeles aqueduct, the 233-mile watercourse by which the city of Los Angeles is to procure its domestic water supply from the Sierra Nevadas, crosses the Antelope Valley at its upper end, about one hundred miles northwest of Los Angeles, in the shape of a concrete and steel pipe with a total length of 21,685 feet. The concrete approaches end where the head exceeds 70 feet, and their total length is 6,149 feet, leaving 15,536 feet of steel pipe, 10 feet in diameter, with a head ranging from 70 feet to a maximum of 200 feet. This line was completed in the Fall of 1912 at a cost of $249,200, and is claimed by engineers of the Los Angeles aqueduct to be the longest line of pipe of such large diameter in existence. The thickness of the steel ranges from ¼ inch to ⅝ inch.

On the night of February 20th, following three days of heavy rainfall, the two concrete piers supporting the siphon at a point near the center of the valley, where the line crosses a ravine, were undermined and fell on their sides. The siphon which was in operation at the time was ruptured, permitting the water to flow out under a very high velocity. There then followed a collapse of 10,000 feet of the siphon. The line lies half buried in the ground, so that the under half was uninjured, but the upper half was driven in with such great force that the upper semi-circumference was bent downward, in many places, to within a few inches of the lower semi-circumference.

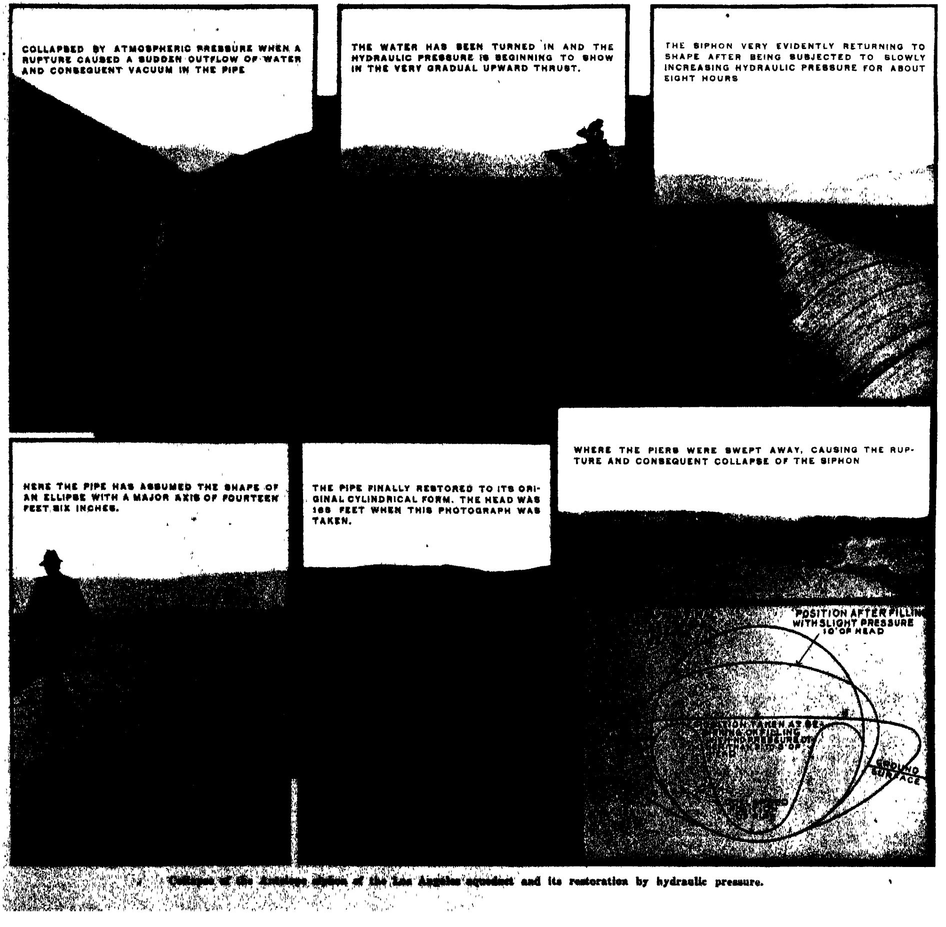
At a point 400 feet from the northern or inlet end of the steel pipe, several of the plates were torn and the rivets sheared, the rupture at this end not being fully explained. The pipe was open at both ends, allowing the free entry of air. There were no summits in the pipe and no air valves were installed. The concrete approaches, and the ⅝-inch plate, were uninjured.

The pipe, on the morning after the mishap, had a "U" shape as shown in the illustration. Its rehabilitation by water pressure, while simple in the extreme, is noteworthy on account of the magnitude of the work, and has attracted the attention of the engineering world.

Under the direction of the chief engineer, Mr. William Mulholland, new plates to replace those torn, were rolled, sheared, and punched, transported by wagon 35 miles across the desert to their destination and riveted into place. New piers had been constructed in the *interim* to replace those which had been washed away.

The aqueduct was then placed in operation. A flow of 750 miner's inches, 405,000 gallons per hour, was then turned in. Under a head which at first did not exceed two feet, the heavy steel plates, upon which steel hammers had had little effect in the attempt at straightening, began very slowly to "iron out." As the pressure was slowly permitted to increase, with a gradually added flow up to 2,000 miner's inches, 1,080,000 gallons per hour, the pipe assumed what will be to the layman the unusual shapes shown in the accompanying diagram, until it returned to its truly cylindrical form. At one time, it assumed the shape of an ellipse with a major diameter of 14 feet 6 inches

To the engineer it will be interesting to know that in this transition, none of the longitudinal seams were sheared and that only a small amount of caulking of the last named seams was necessary In some instances, for distances of 400 or 500 feet at a stretch, the return to rotundity was made with no damage whatsoever to the pipe. At other points, only the caulking tool was required. For repairing the damage due to collapse, the expense did not exceed $250, and for the whole work of repair, which included cost of and fitting in the new plates, building concrete piers, and preparing against the repetition of the accident, the amount expended was within $2,200.



COLLAPSED BY ATMOSPHERIC PRESSURE WHEN A RUPTURE CAUSED A SUDDEN OUTFLOW OF WATER AND CONSEQUENT VACUUM IN THE PIPE

THE WATER HAS BEEN TURNED IN AND THE HYDRAULIC PRESSURE IS BEGINNING TO SHOW IN THE VERY GRADUAL UPWARD THRUST.

THE SIPHON VERY EVIDENTLY RETURNING TO SHAPE AFTER BEING SUBJECTED TO SLOWLY INCREASING HYDRAULIC PRESSURE FOR ABOUT EIGHT HOURS

HERE THE PIPE HAS ASSUMED THE SHAPE OF AN ELLIPSE WITH A MAJOR AXIS OF FOURTEEN FEET SIX INCHES.

THE PIPE FINALLY RESTORED TO ITS ORIGINAL CYLINDRICAL FORM. THE HEAD WAS 185 FEET WHEN THIS PHOTOGRAPH WAS TAKEN.

WHERE THE PIERS WERE SWEPT AWAY, CAUSING THE RUPTURE AND CONSEQUENT COLLAPSE OF THE SIPHON

Collapse of the Antelope siphon of the Los Angeles aqueduct and its restoration by hydraulic pressure.

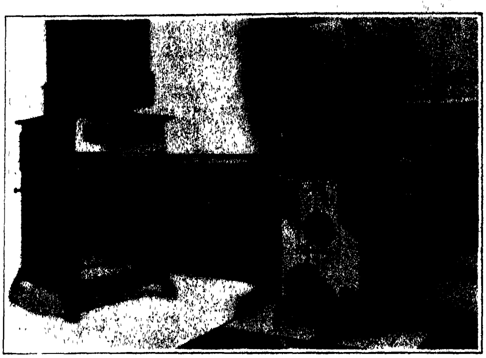
A New Rotating Sleeve Motor

A NEW motor of the non-poppet valve type has just appeared in which a single sleeve acts as a valve, whereas practically all other motors of the sleeve valve type have two sleeves. This motor also differs from others in the fact that the sleeve revolves continuously at one quarter crankshaft speed. A few years ago a rotating sleeve motor was introduced from France, but the present motor differs from that in the fact that it has a stationary sleeve, or cylinder, around which the rotating sleeve operates. An important feature of the new motor is that both the stationary sleeve or cylinder and the rotating sleeve may be removed readily from the water-jacket without the necessity of disassembling the engine and separating the cylinder from the gear-case in order to reach the sleeve. Not even the timing of the gear is disturbed in removing the cylinder or the sleeve valve.

The improved motor is made up of four principal parts. Outside there is the common cylinder casting, containing the water-jacket portion. Within this is placed a fixed sleeve with enough clearance around it to receive the rotating sleeve Last of all, comes the piston, which reciprocates within the fixed sleeve In the photograph showing the various parts, the rotating sleeve is indicated at *A*, the fixed sleeve, or cylinder, at *B*, while the third view shows the sleeve, the cylinder, and the gearing assembled. The sleeve *A* is connected with a spiral gear *G* by means of square-jaw clutches. The gear *G* is engaged by a spiral pinion *P*, mounted on a shaft that lies parallel with the crankshaft The valve shaft is driven by geared connection with the crankshaft, as shown in the photograph of the motor with the cover of the gear-case removed The sectional drawing shows how the gear wheel *G* is clamped between the bottom of the water-jacket and the top of the crank-case and is not disturbed when either the valve sleeve or the fixed sleeve is removed. The fixed sleeve, which is indicated by a solid black line in the drawing, is formed with an enlarged water-jacketed head that is held in place by means of four bolts. The spark plug is inserted through the center of this water-jacketed head

The revolving sleeve is formed with two rectangular ports *Q* The stationary sleeve, or cylinder, also has two ports, marked *S* and *E*, the former being the intake port, and the latter the exhaust port. These are opened successively at the proper time by the port *Q* in the revolving sleeve *A* Because the sleeve revolves at one quarter crankshaft speed, it must have two ports which alternate in their functions This gives each port ample time to cool, and permits of better lubrication Oil under pressure is supplied to the sleeve through a spiral groove therein.

The timing of the motor is as follows: The intake begins to open at 14 degrees past top dead center, and attains full opening in 82 degrees. Then it remains at maximum opening while the crank travels 28 degrees, closing thereafter in 82 degrees, giving a total range of 192 degrees. The exhaust valve has a range of opening covering 228 degrees, of which 110 degrees is required in obtaining maximum opening. Then there is a continuance of 8 degrees at maximum opening and closing in 110 degrees, thus bringing the exhaust to closed position at 5 degrees past the top dead center. The exhaust starts to open at 48 degrees ahead of the bottom dead center, and the intake starts to open 14 degrees after top dead center, and is closed at 26 degrees past bottom center. These timings have been adopted after careful test to work out a motor which will idle at slow speed and develop maximum horse-power at relatively high crankshaft speed. With this timing on a six-cylinder block motor, with cylinders of 3½ by 5¼ inches, operating at 2,400 revolutions per minute, 55 horse-power has been obtained on a block test. The weight of the motor is but 550 pounds. The motor is lubricated by a force-feed system, with pressure supplied by a gear pump located in the crank-case.



The oven has a one-fifteenth horse-power motor connected by a belt with the fan which maintains a circulating atmosphere within the oven.

Science and the Tariff

By Dr. E. E. Pickrell

DUE to extensive publicity of recent years, everyone realizes that the United States Government employs a scientific means to provide pure food and drugs to the consuming public. But few people are aware that science is a valuable assistant to "Uncle Sam" in the enforcement of the tariff laws in ascertaining the duties on imported merchandise, and that the application of every new tariff is more dependent on science. How many persons realize, when they purchase an article made wholly or in part of imported cotton yarn, or cloth, that the United States Government, in collecting the duties on that article, took into consideration the fact that cotton yarn and cloth are hygroscopic, and the amount of moisture they contain is dependent upon the temperature and relative humidity of the atmosphere? But few have a knowledge that in the administration of the cotton schedule of the tariff act of October 3d, 1913, the U. S. Treasury Department has taken into consideration the moisture content of cotton yarn and fabric. Schedule I (otherwise known as the cotton schedule) of this act provides for cotton yarn and fabric at an *ad valorem* rate of duty and establishes the lines of demarkations of the various classifications, according to the yarn number.

In the ascertainment of the yarn number the weight of the yarn, or cloth, is one of the principal factors. The moisture content, therefore, bears an important relation to the weight, and consequently to the yarn number. The quantity of moisture cotton cloth or yarn contains depends upon the temperature and relative humidity of the atmosphere. As an illustration, let us take a sample of 840 yards of cotton yarn, which under atmospheric conditions of 70 deg. Fahr. temperature and 65 per cent relative humidity, weighs 116.67 grains. The yarn number of this sample is 60, for a No. 1 cotton yarn is a yarn 840 yards of which, under these atmospheric conditions, weighs 1 pound, or 7,000 grains, and a No. 60 cotton yarn weighs 1/60 of 7,000 grains, or 116.67 grains. In this sample the proportion of moisture to dry cotton is as 8½ parts to 100 parts, or 9.14 grains to 107.53 grains.

Expose this sample for a sufficient period of time to an atmosphere of 73 deg. Fahr. and 46 per cent relative humidity, and it would weigh 114.19 grains. Its yarn number would be 7,000 divided by 114.19, or 61.3. The moisture content would be 114.19—107.53, or 6.66 grains, representing 6.19 per cent of the dry cotton. Place the same sample in an atmosphere where the thermometer reads 68 deg. Fahr. and the hygrometer records 97 per cent, and its weight would be increased by 121.95 grains, which is equivalent to a yarn number of 57.4. The moisture content would be 121.95—107.53, or 14.42 grains, which represented in percentage of the dry cotton contained in the sample, is 13.41. It is, therefore, quite apparent that a few degrees in temperature and a variation in the relative humidity has an appreciable effect upon the weight of cotton yarn, and consequently the yarn number.

If, on the day of importation of a consignment of cotton yarn into the port of New York, the thermometer registered 73 degrees and the hygrometer returned a reading of 46 per cent, its yarn number, as ascertained, would be 61.3, and the merchandise, accordingly, classified under paragraph 250 of the tariff act as cotton yarn exceeding 59s to 79s at 22½ per cent *ad valorem*. But, provided the temperature and humidity had been 68 degrees and 97 per cent, respectively, the yarn number would necessarily have been 57.4, and in the classification of the importation, a rate of duty of 20 per cent *ad valorem* would have been assessed as for cotton yarn exceeding 40s to 59s. To avoid these differences of

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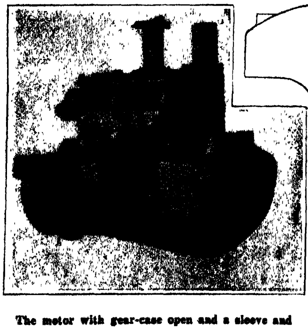
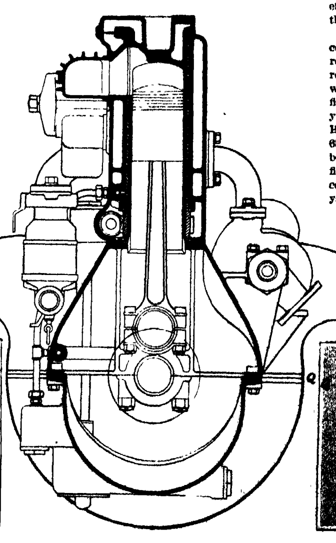
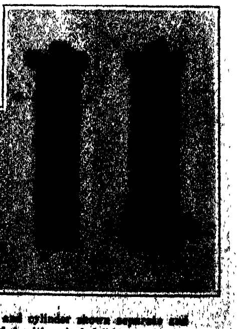


The motor with gear-case open and a sleeve and cylinder set on top.



Section showing the mounting of the sleeve valve and the cylinder.



The sleeve and cylinder shown separate and assembled with spiral driving gear.

X-Ray Photographs of Flowers

By John W. N. Sullivan

THE discovery of the remarkable penetrative powers of X-rays has received applications in surgery and medicine for some time. But, in one sense, the X-rays which are produced in the ordinary way have the defects of their merits; they are valuable for their penetrative powers, but for some work these are too marked. It is found that if the X-rays from an ordinary Crookes tube are used for viewing the chest of a man, for instance, then the addition or subtraction of a few articles of clothing makes little or no difference to the resultant photographic image. Such high penetrating rays were found quite useless for obtaining radiographs of such delicate structures as a feather, leaf of a plant, or the petal of a flower.

But it has been recently found that by using a specially designed tube under suitable conditions, giving out the softest possible X-rays, not only could radiographs of such structures be secured, but that they showed sufficient detail to admit of magnifications varying from 10 to 40 diameters. A tube capable of producing these rays was designed by Lindemann, who suggested the introduction into the tube of a window made of lithium glass. Such a window offers but a slight resistance to the passage of the softest X-rays it is possible to produce.

Tubes of this type have been used by radiographers all over the world for several years, but it was not until the last two years that their use in obtaining radiographs of thin transparent objects was fully recognized. Beautiful radiographs of flowers, insects, and opaque objects were first exhibited in England at the exhibition of the Royal Photographic Society held in London in October of last year by Pierre Goby, for which he was awarded a medal.

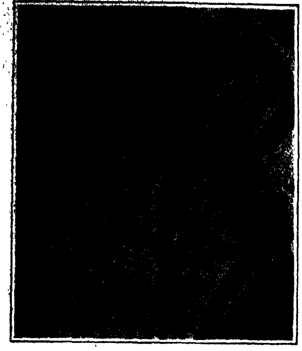
The apparatus for producing such radiographs has since been considerably simplified and the experiments of Hall-Edwards have been made with tubes which had been in use for several months, and with but the addition of a few simple pieces of apparatus, which can easily be constructed by anyone possessing an elementary amount of technical skill.

The tube with which he has achieved the best results is a Bauer heavy anode tube, provided with a Bauer regulator. This tube has been in daily use for months, and the glass is heavily coated with platinum. For ordinary use it requires to be constantly lowered, as it becomes high after a medium exposure.

When working, the vacuum is lowered to such an extent that the cathode stream becomes quite visible, and should it disappear during the somewhat long exposure necessary, more air is pumped in from time to time. For flower studies Ilford X-ray plates are used, enclosed in a couple of Tyler's light-tight envelopes.

The plate is placed at a distance of from three to five feet from the tube, and the proper exposure is learnt by experiment. The flowers, leaves, berries, insects, or small animals are placed upon the envelopes, care being taken that the emulsion side of the plate is uppermost and the tube is placed over the center of the plate.

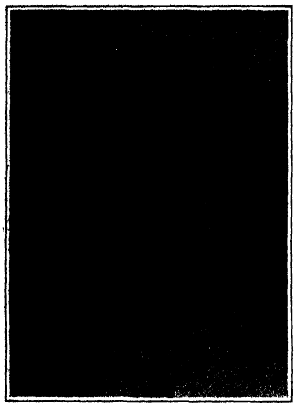
A specimen plate was produced by placing the tube a distance of 8 feet 6 inches from the photographic plate. A twelve-inch coil with a mercury jet interrupter was used. Six amperes from a direct 220-volt supply was passed through the primary, a resistance of about 12 ohms also being used. The exposure was 90 seconds. The negative was developed with a hydroquinone-metol developer, the development taking about 10 minutes.



X-ray photograph of carnations, tulips, and daisies.

Should the flower or other object to be radiographed be of extremely fine texture, it is well to increase the distance between the plate and the tube. In radiographing insects no envelopes should be used, as the grain of the paper is apt to obscure some of the fine details which would be visible without them.

Stereoscopic radiographs may be obtained by first placing the tube 1½ inches from the central line to the right, and in the second case the same distance to the left. The ordinary stereoscopic changing box does not allow the necessary soft rays to reach the photographic plate.



X-ray photographs of anemones.

Micro-radiographs can also be obtained, and Dr. Hall-Edwards hopes shortly to place on the market a simple device for obtaining these with the minimum of trouble and expense.

Inasmuch as these radiographs show the internal structure of flowers, insects, and other objects in addition to their outline, they open up a great field for research. Their use largely dispenses with the need for dissection, while the periodic radiographing of a growing plant or small animal opens up a field of great value to the naturalist.

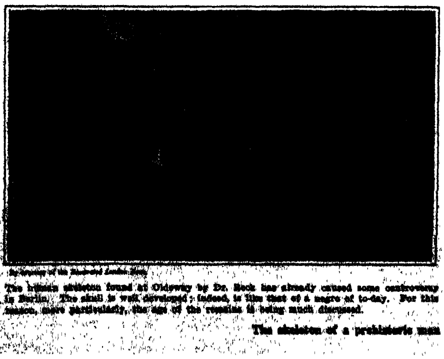
A Human Skeleton One Hundred and Fifty Thousand Years Old

DR. HANS RECK, of Berlin, has discovered, at Oldoway, in the north of German East Africa, the skeleton of a man who lived, in all probability, some 150,000 years ago. The photographs reproduced were supplied by the Doctor to the *Illustrated London News* and were accompanied by a note to the editor of that weekly. The following translation is from the German:

The rare animal fossils of the Tertiary Period yielded by Africa decided the Geological Palaeontological Institute and Museum of the University of Berlin to excavate the Oldoway "pit." In three months, some 1,700 bones were found and taken to the expedition's camp, there to be sheltered carefully under primitive, straw-roofed huts until they could be numbered, classified, and packed for their long journey. The huts in question were full of bones and huge relics of elephants. Most of the tusks discovered were surprisingly long, very light, and straight. The best was 3.8 meters (10 feet 5 inches) in length. Then there were represented the rhinoceros, the hippopotamus, numerous antelopes and gazelles, as well as pigs, rodents, and beasts of prey.

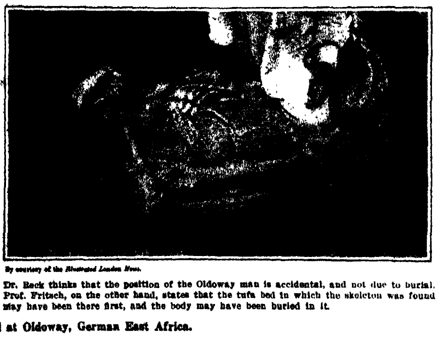
It was frequently difficult to obtain the bones. Not only was there a dearth of water and a blazing sun, but wild animals would arrive unexpectedly and disturb the diggers. Rhinoceroses, in particular, chased the men from time to time, sending them running through the trees and holding them prisoners for hours. The crumbling walls of the pit provided another obstacle. A precious relic would be seen in about the middle of the 50-foot wall, and those seeking it would have to be lowered by ropes, or rude ladders would have to be made and so set that the "find" could be reached. When, by good fortune, a place was found upon which a man could stand, the task was easier, for the natural "platform" could be enlarged by the pick.

One day brought with it a great surprise. On the steep incline of the "pit," the excavators found signs of a human skeleton, which was soon laid bare and protected by a straw roof. The discovery was seen to be of extreme age, and in a remarkably fine condition. The stratum about it was undisturbed, proof that it owed its position not to having been buried at the bottom of a hole dug down through several strata, but to having been contemporaneous with the stratum in which it rested. And that stratum is so old geologically that the skeleton must date at least from the Diluvial Period of Africa, which, it may be noted, synchronizes with the Ice Period of Northern Europe. No more precise date can be assigned to it until it has been compared with fossils found during the same excavations. It is typically negroid, and the first fossil human form found at Oldoway. The skull is highly developed, narrow and long; the head is set deep in the shoulders; the chest is massive. The position of the skeleton calls for notice. The legs were drawn up sharply, and obviously in a natural manner. This is additional argument in favor of the belief that the body was not buried; and must be taken in conjunction also with the facts that there are no traces of entombment, and that the contorted attitude is unknown in any case of burial by man. It would seem that the man was driven into the lake which was once above the spot on which his remains were found, or met with an accident on it, and was drowned. The body would be quickly covered with the mud at the bottom of the water and tufa, and so be protected from disturbing influences.



By courtesy of the Illustrated London News.

The human skeleton found at Oldoway by Dr. Reck has already caused some controversy in Berlin. The skull is well developed; indeed, is like that of a negro of to-day. For this reason, more particularly, the age of the remains is being much discussed.



By courtesy of the *Illustrated London News.*

Dr. Reck thinks that the position of the Oldoway man is accidental, and not due to burial. Prof. Fritsch, on the other hand, states that the tufa bed in which the skeleton was found may have been there first, and the body may have been buried in it.

The skeleton of a prehistoric man found at Oldoway, German East Africa.

The Motor-driven Commercial Vehicle

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The Editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles.

Road Construction by the "Penetration Method"

IN the "penetration method" of road construction a permanent foundation is first laid, after which large crushed stone is applied according to the road specifications A "hot road oiler" is then run over the road, applying a hot bituminous binder, which is forced into the layer of crushed stone under pressure, filling up the interstices between the stones, and holding them in place. As the binder hardens, the stones are held more firmly in place, forming a solid mass of crushed stone and bituminous material When the first course is finished, another layer of stone is rolled into place, the stones coming in contact with each other by the pressure of the steam roller, again a hot binder is applied by the "hot road oiler," filling up any crevices. In this way a solid road is obtained with no openings between the stones, and no moisture can get into the road and disturb its surface when it freezes, as is frequently the case in macadam roads The stones are gripped in the bituminous binder, and all spaces filled up, so that the stones cannot be picked out by automobile traffic Of course, a road of this type has no dust.

The machine here illustrated is specially constructed to deliver the hot bituminous binder under pressure. It is a 5½-ton truck, having sliding gear transmission with wide ranges of speed The main tank holds 750 gallons of binder The binder in the tank is heated by coils of pipe in the tank, which coils are filled with steam This steam is generated in the flash boiler at the rear of the truck. The boiler is fired by fuel oil, which is carried in a small tank on the right-hand side of the truck, and hence invisible in our illustration The steam from the boiler is also used to run a reciprocating "plunger type" air compressor The air pressure forces the binder in the large tank into the road. A second small tank on the right-hand side of the truck carries the water for the boiler The boiler is also provided with an air primer for starting the fire underneath the boiler

Suitable arrangements have been provided for straining the binder when it is taken from the tank, before reaching the distributing manifolds situated underneath the boiler at the end of the truck The operator is stationed at the rear of the truck, directly above the manifolds, so that he can control and regulate the application of the binder to the road. Provision is made for attaching a nozzle and hose to the distributing manifold and applying the oil locally by hand

It can readily be seen that a full range is reached for the application of binder, by varying the air-pressure on the tank, by opening and closing the manifold nozzles, by varying the temperature at which the binder is applied, and by running the truck at different speeds. Binder can be applied at the rate of from ¼ gallon per square yard to as much as 2 gallons per square yard

Machine for applying hot binders under pressure in road construction.

Marvelous Growth of the Motor Truck Industry

OF course we all know that the motor truck industry has shown a remarkable development in the past few years. There is plenty of evidence of this, not only on the streets of our large cities, but on the country highways. Nevertheless, we believe that a picture of this growth will startle even the most observant man.

According to statistics published in the *Power Wagon*, there were, in 1910, 11,000 commercial motor vehicles. The next year the number had grown to 20,000. Thereafter the figures more than doubled each year. The year 1912 ended with 45,000 motor trucks, and last year the final figure rose to 95,000.

This geometrical progression cannot go on forever or in the next few years there would be more commercial than pleasure vehicles in service, and another decade would find more motor trucks than people in the United States But as yet there appears to be no checking of the phenomenal growth So far 1914 appears to be holding its own Already the number has reached 125,000, and that for only a third of the year, viz., to May 1st.

We have endeavored to picture this remarkable increase by letting one vehicle represent ten thousand. Then the growth year by year is, roughly, as shown in the accompanying drawing. It will be noted that 1912, 1913, and 1914 have each half a truck to their credit that is not shown in the drawing.

Quoting again from *Power Wagon*, New York has 8,900 motor trucks in service, and Chicago 4,300, while third position is held by Los Angeles, which in three years has jumped from eighth position, with 800 trucks, to third position, with 4,000. Philadelphia holds fourth position with 3,000 motor trucks.

Most significant has been the progress in the use of "fleets" of trucks. There are now 149 concerns using 20 or more trucks, and of these twenty-two operate "fleets" of 100 or more. Among owners of five or more trucks department stores lead, with 2,758 machines; express companies come second, with 2,040 machines; and brewers third, with 1,543 machines. In actual numbers of trucks, furniture, hardware, and other trades lead, although they do not use as many trucks in fleets.

Pintsch Gas Residue for Motor Fuel

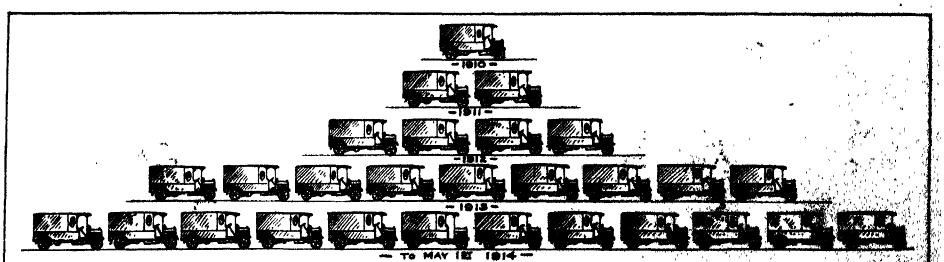
WHAT with the comparatively high price of gasoline anything that holds even the remote promise of taking the place of that commodity quite naturally is of interest to users of heavy motor vehicles, and in this connection the experience of a prominent gas company in Texas should prove doubly interesting, for the company has succeeded in using with its own vehicles a kind of fuel that never has been used before. The company in question is a large producer of Pintsch illuminating gas for residences and railroad trains and until very recently had considered it quite a problem to be rid of the great quantities of residue which accumulate. Previously, this residue, which is brownish in color and a hydro-carbon in nature, had been permitted to flow away and mingle with the waters of a large river. Now, however, a way has been found not only to use the residue, but to materially reduce the expense of operating the company's heavy trucks as well. The residue is passed through a small still and collected as a slightly lighter and colorless liquid. This liquid then is mixed with half its volume of commercial petroleum, the resultant compound costing the company all told 11 cents a gallon. In using the compound the ordinary gasoline carbureter is used and no need has been found for making adjustments of either fuel or air supply. Some slight carbonization results from the use of the fuel, but as this is a light, flaky deposit, it is of small consequence and blows away easily through the exhaust pipes. In starting during cold weather slight difficulty also is experienced by the drivers, though this is overcome by "spinning" the motor rapidly. It is stated that the company not only uses the new fuel itself for all of its vehicles, thus effecting a material economy in operating expenses, and, incidentally, obtaining considerably more power, due to the greater number of heat units contained in the fuel, but that it is producing it in limited quantities for the use of others. It is expected that other producers of Pintsch gas also will make some attempt to turn their unprofitable residue into profit as a result of the experiment of the Texas company.

Motor Truck Notes and Queries

L. G. V. writes: "What devices are there on the market intended to prevent the theft of a motor car or truck? Our delivery car is driven by one man who often has occasion to leave the machine standing for 15 or 20 minutes while he enters an apartment building to receive the day's orders. There have been several thefts of automobiles reported recently in our city, and as our car consists of a new chassis of the pleasure type with a panel body mounted thereon, it would make as valuable 'pickings' as would a high-grade touring car."

A. Nearly every new car is provided with a certain form of plug or lock and key that cuts off the ignition current. If a plug is ordinarily used, its place may be taken by a nail or cotter pin of the proper size, while the ordinary ignition lock is guarded only by a "blank" key or one that can be easily duplicated. Consequently, neither of these means is especially efficient against the experience of an automobile thief. Especially designed ignition locks are made, however, in which a famous type of burglar proof tumbler lock must be opened with

(Concluded on page 526.)



Motor trucks more than double their numbers each year. Each truck here represents ten thousand.

RECENTLY PATENTED INVENTIONS

[illegible] by special arrangement with the inventors. Terms on application to the Advertising Department of the Scientific American.

Pertaining to Apparel.

GARMENT.—B. I. Flegel, 416 E. 12th St., New York, N. Y. The invention has for its purpose the provision of a garment, such as a rain coat, cloak, and the like, and provided with a convertible collar and hood arranged to permit its use as an ornamental collar or as a hood, with or without a military effect.

GARMENT FORM.—H. T. Palmenberg, 710 Broadway, New York, N. Y. This inventor provides a form arranged to provide a cushion between the body and the stand, with a view to prevent the lower end of the body from striking the base of the stand, to the detriment of the body in case the fastening device for fastening the body to the stand is loosened.

Electrical Devices.

ELECTRIC LAMP SOCKET.—M. Reich, 311 W. 56th St., New York, N. Y. This improvement reduces the labor of installing an electric lamp socket; enables an operator to install the socket in service position; simplifies the construction and mounts the socket readily in service position.

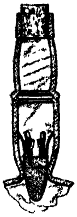
Of Interest to Farmers.

AUTOMATIC HEN MARKER.—F. H. Pebbles and K. D. Grant, 2230 S. 22nd St., Philadelphia, Pa. This invention provides a nest construction with devices whereby, when a hen enters the nest, a drop of ink or paint of any suitable nature will be caused to drop upon her back. By this means, the hens which enter nests will be marked, so as to clearly identify them and distinguish them from the hens which do not frequent the nests.

PICKER'S SACK.—A. H. Labrabee, Corona, Cal. The primary object here is to provide a top for a sack, which will keep sticks and trash from falling into the sack during the picking operation. An object is to provide a sack which is so constructed as to render it impossible for a picker to clip fruit directly into the sack, thereby injuring the fruit by the fall.

Of General Interest.

NON-REFILLABLE BOTTLE.—W. W. Smith, address Stanley S. Spencer, Darlington, Md. An object of this invention is to provide a receptacle for holding liquids from which the liquids may be readily poured, but into which the liquids cannot be readily returned after it is once emptied. The device is cheap to manufacture.



NON-REFILLABLE BOTTLE.

SEA-ANCHOR.—F. Rouse, 2702 Hyde St., San Francisco, Cal. This invention provides a spreading frame for an anchor adapted to maintain its operative position irrespective of added weight; provides a buoy for said anchor to maintain the equilibrium thereof; and provides oil and a ballasting compartment adapted to hold and distribute a liquid to affect the surface of the water in which the anchor is held when in service.

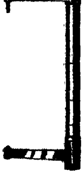
CALCULATOR OR ABACUS.—R. C. Bennett, care of A. P. Bennett, 144 W. 87th St., New York, N. Y. This invention refers to counting elements known as abaci, and has reference more particularly to the frame structure, which comprises a member carrying the counting elements and provided with supports at the ends of such a shape that the said member is in normal position at all positions of the supports.

SUPPORT FOR NOTE BOOKS AND THE LIKE.—J. Walker, Augusta Works, 19-21 Warstone Lane, Birmingham, England. The invention provides the frame which carries the book with means for preventing accidental turning-over of the leaves, with means for adjusting the same vertically and angularly in a horizontal direction, with means for adjusting the slope of the same, and with means, when it is used as a typewriter, for fixing it securely to the frame of any ordinary machine.

VENTILATOR.—J. A. Hosse, 3536 Sunnyside Ave., Falls of Schuylkill, Philadelphia, Pa. Mr. Hosse's invention relates to ventilators of the type used upon the tops of chimneys, flues, and the like, for the double purpose of preventing entrance of rain water into the chimney and of affording ready means for the escape of smoke from the chimney, while at the same time adding an ornamental appearance to the chimney top.

Hardware and Tools.

MICROMETER CALIPER.—E. W. Marion, 1832 Butler St., Philadelphia, Pa. This improvement has reference more particularly to a device which comprises a pair of relatively adjustable heads provided with measuring points, and means between the heads for altering the normal fixed distance between them. It provides a caliper with which measurements from zero to any number and fractional part of standard units, as machine practice may require, can be made by a simple adjustment of the parts.



MICROMETER CALIPER.

Household Utilities.

UTENSIL KNOB.—E. C. Fritz and E. C. Anderson, Somerset, Wis. Address the former, Somerset St., Croix Co., Somerset, Wis. The invention relates to knobs for use with cooking utensils and the like, and refers more particularly to a device which comprises a knob proper, fashioned from an elongated spirally-disposed member, and means for attaching said member directly to the utensil or body

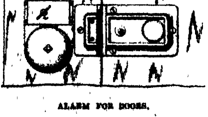
Machines and Mechanical Devices.

ALARM WATCH.—J. S. DeWitt, 306 N. Arthur St., Pocatello, Idaho. The more particular purpose here is to provide a watch with means for mounting it upon a person's wrist or ankle and providing said watch with additional means for producing a gripping or squeezing effect upon the wrist or ankle, for the purpose of attracting the attention of the wearer, and thus serving the purpose of an alarm.

APPARATUS FOR MANUFACTURING ICE.—L. C. Bond, Box 241, Beaufort, Charleston, S. C. This invention provides an apparatus whereby clean ice can be manufactured from water containing impurities in suspension. This is attained by providing moving receptacles adapted to receive the water to be frozen and positioned in the brine tank, the temperature of the brine being maintained below the freezing temperature of the water.

MATRIX MARKING MACHINE.—W. A. Heidel, 427 Jackson St., Mankato, Minn This invention provides for recording matter to be printed and preserving a paper record of such matter, to be used as a matrix from which slugs may be made; simplifies the type bar mechanism so that a number of independent type bars may be lowered to different levels, each type bar carrying a plurality of type, the parts so arranged that the letters to be printed in a line are brought together by virtue of the levels of the several type bars; provides mechanism for restoring the type bars to a predetermined level; provides for properly alining and clamping type to enable them to make an impression in the printing of a line, and improves the mechanism for holding the type characters in position for making impressions. The machine may be produced at a very nominal cost.

ALARM.—J. Richman, 570 Ralph Ave., Brooklyn, N. Y. This alarm is more especially designed for use on doors and arranged to sound an alarm when a person pushes the locked door. For this purpose use is made of an alarm device provided with an escapement wheel and an escapement lever, and a locking and releasing device for the said lever to normally lock the same against movement, the said locking and releasing device being adapted to be engaged by the door bolt when the latter is in closed position.



ALARM FOR DOORS.

HOOD FOR TYPE WRITING MACHINES AND THE LIKE.—M. W. Potter, Red Lodge, Mont. This invention relates to a collapsible hood to constitute a protective cover for typewriting machines and the like, and particularly to a hood comprising a flexible covering, and a framework including a series of separate foldable bows to maintain the cover in distended form, or to collapse the cover.

CRULLER SHAPING MACHINE.—I. Heine, 553 W. 48th St., Manhattan, N. Y., N. Y. The object here is to provide a machine which will automatically shape dough fed into the machine in a predetermined shape, as, for example, a cruller, and deliver the shaped dough, further, in shaping the dough by the machine, all waste of dough is eliminated.

STOP MOTION.—K. Bloat, care of Scranton Silk Machine Company, Scranton, Pa. An improved stop motion is provided by this invention for use on reeling machines to stop positively and quickly the reel in case of the breaking of a thread or yarn or the running out of the yarn from its spool. The device requires no fine adjustment or sensitive balancing by skilled workmen, and the parts are prevented from being actuated by mere vibration incident to the running of the machine.

Railways and Their Accessories.

RAILWAY CAR.—J. W. Spaur, care of Emmet Carey, Philipsburg, Mont. This inventor provides a construction of cars whereby the car ends will be disposed at an oblique angle transversely of the track, and hence upon a collision, the cars will not tend to telescope with the ordinary form of car, but by reason of the car ends being disposed in substantially parallel relation and obliquely with respect to the track, will tend to be thrown to one side of each other as they come together by impact of collision.

SWITCH LOCK.—J D Moore, Folkston, Ga The purpose here is to provide an arrangement which will effectively hold the switch point against the main rail and which may be readily released when it is desired to open the switch by connections of such character as that they may be actuated when the switch throwing lever is raised

AUTOMATIC WHISTLE.—G. R. Dunn, R F. D. No. 6, Elkhart, Ind. This invention provides means which may be disposed alongside the track for operating the whistle independently of any attention on the engineer's part It provides means for automatically operating a whistle which may be disposed at predetermined points, so as to insure the sounding of the whistle at these points.

Pertaining to Vehicles.

AMBULANCE AUTOMOBILE—F. E Campbell, 241 W. 23rd St., New York, N. Y. This invention provides means for, at will, converting an automobile of usual construction to adapt the same for use as an ambulance; provides an ambulance which may be arranged for the introduction of a stretcher without forcing the persons carrying it to step into the street, provides means whereby patient and stretcher may be introduced sidewise into an automobile, and thence moved across the body to provide a passageway for passengers entering the same side of the automobile, provides an extension to the automobile body for holding a portion of the person of a patient; and provides means over which the stretcher may be moved in depositing the same within the automobile body.

LOCKING DEVICE FOR AUTOMOBILES—J. J Meyer, 306 Lenox Ave, New York, N Y An object here is to provide a device for automobiles to prevent theft thereof by preventing unauthorized persons from running the automobile A further object is to provide a device which can be readily carried about and easily applied, even in the dark

SIGN—L Gottscholl, 462 Broadway, New York, N. Y This sign is for use on automobiles and the like to display a license number or other distinguishing marks which can be distinctly read, which are visible at night for a great distance, and which greatly aid the eye in detecting the number of distinguishing marks as well as aiding the memory in remembering the same.

MANURE CATCHER. C H Ferguson, 66 Lafayette St., Jersey City, N J This catcher is of the type adapted to be applied to horses while being driven through city streets, so as to prevent the dropping of manure in the streets, with the expense to the municipalities of cleaning the streets. It prevents the spread of diseases by manure dust in windy weather

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Note.—Copies of any of these patents will be furnished by the Scientific American for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Inquiry No 9363 Wanted the names and addresses of manufacturers of machinery for printing on intaglio copper plates

Inquiry No 9364 Wanted the name and address of buyer of mica in a crude state

Inquiry No 9365 Wanted the name and address of a manufacturer of machinery for embossing tin foil as is used in packing cigarettes

Inquiry No. 9366 Wanted the name and address of a manufacturer of wire wheels front axles complete with steering or separate, light sheet metal bodies, fuel tanks with cocks pressed steel frames, mufflers, motors of the two-cylinder opposed type cushions and many smaller parts for cycle cars

Inquiry No 9367 Wanted the name and address of a manufacturer of an automatic centering machine

Inquiry No 9368 Wanted, the name and address of glass-bottle manufacturers or glass blowers who can manufacture a glass bottle and perforate it with some 12 small holes in large quantities for export to sell at a popular price

Inquiry No 9369 Wanted the names and addresses of users of Indian Steatite (Soapstone) Corundum and other Indian minerals in quantities

Inquiry No 9370 Wanted the names and addresses of manufacturers of small wooden articles particularly in such soft woods as pine and fir for articles such as toys furniture, etc

Inquiry No 9371 Information wanted where one could buy or have made to order machine to be used for making solid back brushes

Inquiry No 9372 Wanted the name and address of manufacturers of a collapsible box about 12 inches square It must be strongly made to withstand rough usage in transit

Inquiry No 9373 Wanted the name and address of a manufacturer of machinery that will make twine out of scrap paper

Inquiry No 9374 Wanted the name and address of manufacturers of a powder paste which, when mixed with cold water will make a white paste suitable for papering, costing no more than 4 cents per pound in ton lots

Inquiry No 9375 Wanted the name and address of the manufacturer of a separable fastener invented especially for shoes and other articles

Inquiry No 9376 Wanted the name and address of a manufacturer making clock-work mechanism for running window display machines as employed by safety razor manufacture

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Inquiry No 9378 Wanted, the name and address of a manufacturer of smooth metal mirror frames, such as are sold in 5 and 10 cent stores with a mirror and a cardboard back.

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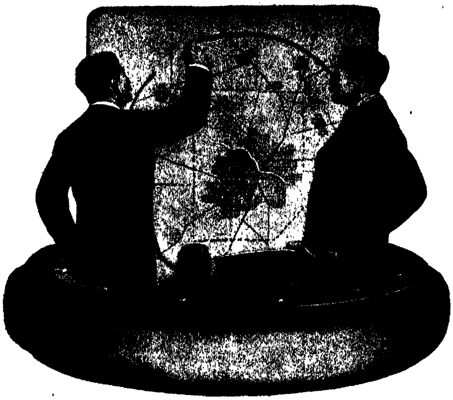

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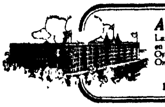

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Motor Truck Notes and Queries

(*Concluded from page 524.*)

the proper key before the current can be turned on. Locks of a similar nature are also provided to be installed in the fuel line. A third class of thief-proof automobile locks is intended to be placed in the gear-shift slot so that the transmission cannot be moved out of the neutral notch. It will be observed that all of these locks are designed solely to prevent the car from being moved under its own power, and it is hardly probable that the thief would take the machine in tow. Locks of this nature may be used on the car when it is stored in a public garage, for the truck can then be moved about by hand to make room for other machines, and yet it cannot be run under its own power without the owner's knowledge.

W. L. K. writes: "I remember the announcement of the manufacturer of a half-ton truck to the effect that his machine had hauled six or seven tons. As I understand that overloading is a practice universally condemned by reputable truck manufacturers, I should think such an announcement would do more harm than good to the industry in general."

A. If the conditions were exactly such as those cited, you are correct in assuming that great harm would be wrought to the truck industry. The load to which you refer was not carried directly on the half-ton truck, however, but was pulled, or hauled, by it in much the same manner as a locomotive draws a train of loaded freight cars. By the use of properly-designed trailers, a small truck may be made to do the work of several cars on a smooth level road, and the strain on the tires, springs, motor, and mechanism in general will be no greater than would be the case were a normal load to be hauled up a hill. A portion of the load should be carried on the truck in order that sufficient traction will be furnished to the wheels so that they will not slip. A truck used in this manner is known as a tractor, while the trailer may be any form of vehicle not propelled by its own power. Special types of trailers have been manufactured to be used in connection with some of the low-priced pleasure cars so that the latter may be easily converted into efficient commercial vehicles.

P. J. N. writes: "An ordinance has recently been passed in our town prohibiting the use of the muffler cutout on motor vehicles. The man who drives our 3-ton truck uses the cutout almost constantly, and tells us that it is necessary in order to give him sufficient power for some of the steep hills. What shall we do if this proposed ordinance is enforced?"

A. It is probable that the driver of your truck shares the popular "superstition" to the effect that eliminating the muffler greatly increases the power developed by the motor. Tests have shown that, in certain instances, a poorly-designed muffler may absorb from 10 to 15 per cent of the power developed by the motor, but that this is only when the engine is working at its full capacity, and that, therefore, the cutout is never really necessary except when the car may be climbing a hill so steep that every ounce of energy is required from it. But the low gear is designed to furnish the proper reduction so that any hill may be climbed without the use of the cutout, and, therefore, its use must be an admission that the motor is in poor condition. We would suggest that you overhaul your motor thoroughly, clean the valves, remove the carbon, and, if necessary, install a larger and more efficient muffler.

The Challenger, "Shamrock IV," Under Sail

(*Concluded from page 530.*)

surface is not any larger in "Shamrock IV" than it is in the older boat.

It is stated that she has shown herself to be very stiff, too much so, in fact, for her own good when the airs are light. The centerboard is to be unshipped, and a recent dispatch says that about five tons of lead is to be taken from the keel. These changes, together with the double

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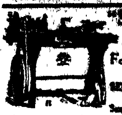

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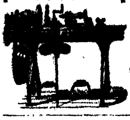

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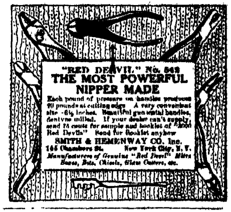

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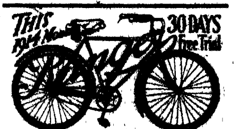

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TOOLS

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[illegible] rig, should improve her average speed over a triangular course under light weather conditions. Furthermore, the removal of the steel centerboard and five tons of lead should reduce the draft of the "Shamrock" from 1½ to 1¾ inches. This, because of her shoal body, should shorten the water-line length by over a foot and reduce her time penalty.

Among our illustrations, the most interesting is that showing the method of stiffening the lofty, hollow, wooden mast of "Shamrock IV," the novelty consisting in a five-strut trussing, which is applied to the mainmast at about two thirds of its height, two of the struts extending athwartship, one projecting forward, and the other two at angles of 45 degrees. The "Shamrock" has been tried in strong winds, and is said to carry her lofty rig without any signs of weakness.

Saving Men from Submarines

(Concluded from page 516.)

siren is a plate covering a telephone transmitter, which can be broken by the rescue party, and communication thus established with the men imprisoned below. If the salvage operations are likely to take some time, arrangements can be made for passing liquid food down the air-pipe, as has been done in the case of miners buried alive under a fall of earth, but with whom communication has been established pending their being dug out. The inventor maintains, however, if his ideas are properly carried out, the crew would be able to stay at the bottom for a very considerable time, as the lockers under the seat in the cylinder are supposed to be kept stocked with provisions, in readiness for such an emergency, and there is a tank which is to be kept filled with fresh water. In one locker there is an electric battery, to give light to the imprisoned men, and in another is compressed oxygen, in case of need. There is also an inner chamber round the boat, filled with compressed ordinary air, which can be used if required. Round the fresh-water tank is another tank, in which sea-water can be admitted by a valve, to be used as ballast, if necessary, and this tank is also to be used as a lavatory and a means of keeping the boat pure and clean—a very important consideration if life is to be maintained for any length of time.

Science and the Tariff

(Concluded from page 526.)

classification and assessment of customs duties on cotton yarn and cloth, due to variations in the atmospheric conditions, the Treasury Department has declared that "whenever the weight is found within 5 per cent of its given equivalent weight in the table it will be necessary to make further trials of at least four samples, and if the average weight is again found to be under 5 per cent, the sample must be conditioned; that is, dried to bone dryness, and a regain of 8½ per cent added back."

Bone dryness of the cotton yarn, or cloth, is a condition in which all moisture is expelled, and this is only accomplished by dryness to a constant weight in a circulating atmosphere at a temperature of 110 deg. Cent. The regain of 8½ per cent added to the bone-dry weight would give the weight of the cotton yarn, or cloth, as if it had been subjected to an atmospheric condition of about 70 deg. Fahr. temperature and 65 per cent relative humidity. The number of the yarn calculated on this weight would be the size of the yarn, provided it had been subjected for a sufficient period of time to these standard atmospheric conditions.

In order to determine accurately the bone-dry weight, the Treasury Department has recently installed in the U. S. Customs Laboratory, Appraiser's Warehouse, 641 Washington Street, New York, a type of a machine known as the Freas electric-conditioning oven. It is the second of its kind to be manufactured, the other one having been placed in the textile division of the Bureau of Standards in Washington.

The oven is built of heavy [illegible] asbestos [illegible] with chamber size 12 inches

[illegible]

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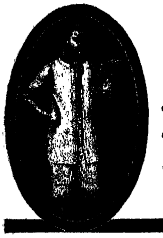

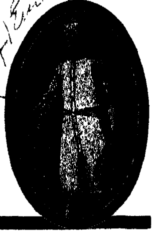

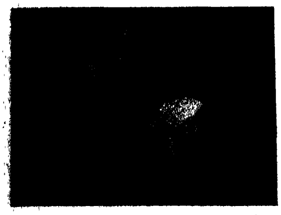

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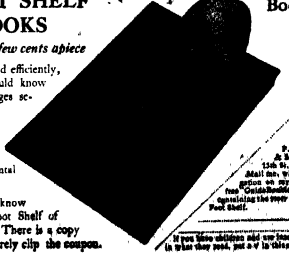

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by 12 inches by 12 inches. The frame of the door is made of heavy aluminum casting insulated with asbestos, and is provided with a double window (mica on the inside and glass on the outside) with drop shield, which permits of inspection of the oven without opening the door. Two small electric lights are placed in the upper inside corners of the chamber, and can be turned on or off by a switch-button on the front of the oven above the door. One of the lights is continuous, and serves as a source of illumination for the oven, and the other is intermittent, and indicates the making and breaking of the contact of the heat regulator.

To expedite the drying, the circulation of heated air supplied to the oven is artificially adjusted by means of a fan situated in the back of the chamber, and driven by a 1/15 horse-power motor, shunt wound, with a speed of 1,100, and a voltage of 110. Complete ventilation, to get rid of the moisture from the substance being dried, is obtained by two openings, or vents, one on each side of the back of the oven next to the bottom; these openings can be closed, or partially closed, by means of metal plates which fit over the openings, and are readily turned.

The heating element, which is wound with a high heat-resisting wire, is situated in the bottom of the chamber underneath a fire-clay plate which contains numerous holes for transmission of heat. The regulation device is fitted in a separate compartment made entirely of metal, and located above the chamber. Its action depends on the expansion of the metal tube through the chamber, operating a lever, which makes and breaks a contact, with proper means to prevent arcing. The lever is extended to serve as an indicator, operating up and down a graduated scale on the outside of the oven. The indicator is moved to the desired temperature by simply turning the knob screw at the bottom of the scale.

The oven is also provided with a double window (mica on inside and glass on outside), with drop shield, on the side of the oven, so as to permit operator to manipulate the horizontal rod with fastened hook for removing and returning baskets from carrier to connecting rod attached to one arm of the balance.

To the top of the chamber is fastened a four-armed horizontal metal frame. At the end of each arm is attached a small pulley, and on these pulleys moves an endless chain, similar to a bicycle chain. This chain is moved by a toothed wheel on the side of the chamber, which, in turn, is moved by a thumb-screw on the outside of the oven. Ten metal hooks are suspended from the chain, and to these are swung ten metal mesh baskets, each of which is 6 centimeters in depth by 4 centimeters in diameter. By the aid of the thumb-screw, the carrier can be turned, so as to bring the baskets into position under the balance to be weighed within the oven.

On top of the oven is an analytical balance of 100 grammes capacity and 1/10 milligramme sensibility, one arm of which is attached to a connecting rod which passes through an orifice into the oven. By turning the horizontal rod which traverses the rear of the chamber, the baskets can be removed from the carrier and attached to the connecting rod which passes into the balance. By moving the carrier the baskets can consecutively be brought in position and attached to the connecting rod. All the baskets are adjusted so that they weigh the same, and are equal to the counterpoise which is suspended from the other arm of the balance.

In the conditioning of the samples of yarns and fabrics weighing 1,000 grains and less, this oven possesses the following features that are superior to other conditioning ovens, both electric and gas, that are now used in the textile trade: (1) It occupies a small space, about three feet square; (2) a constant temperature within 1 deg. Cent. can be maintained; (3) ten samples can be conditioned at one time; (4) an analytical balance, with a maximum load of 100 grammes and 1/10 milligramme sensibility, can be used for weighing the samples within the oven.

[illegible]

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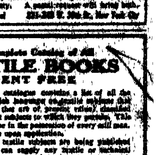

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